IN THIS ISSUE:

FROM WOOD TO CLOTH
MUSIC FROM GLASS

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

MEASURING A YEAR'S CROP OF SNOW IN THE CALIFORNIA AND NEVADA MOUNTAINS. –[See page 594]

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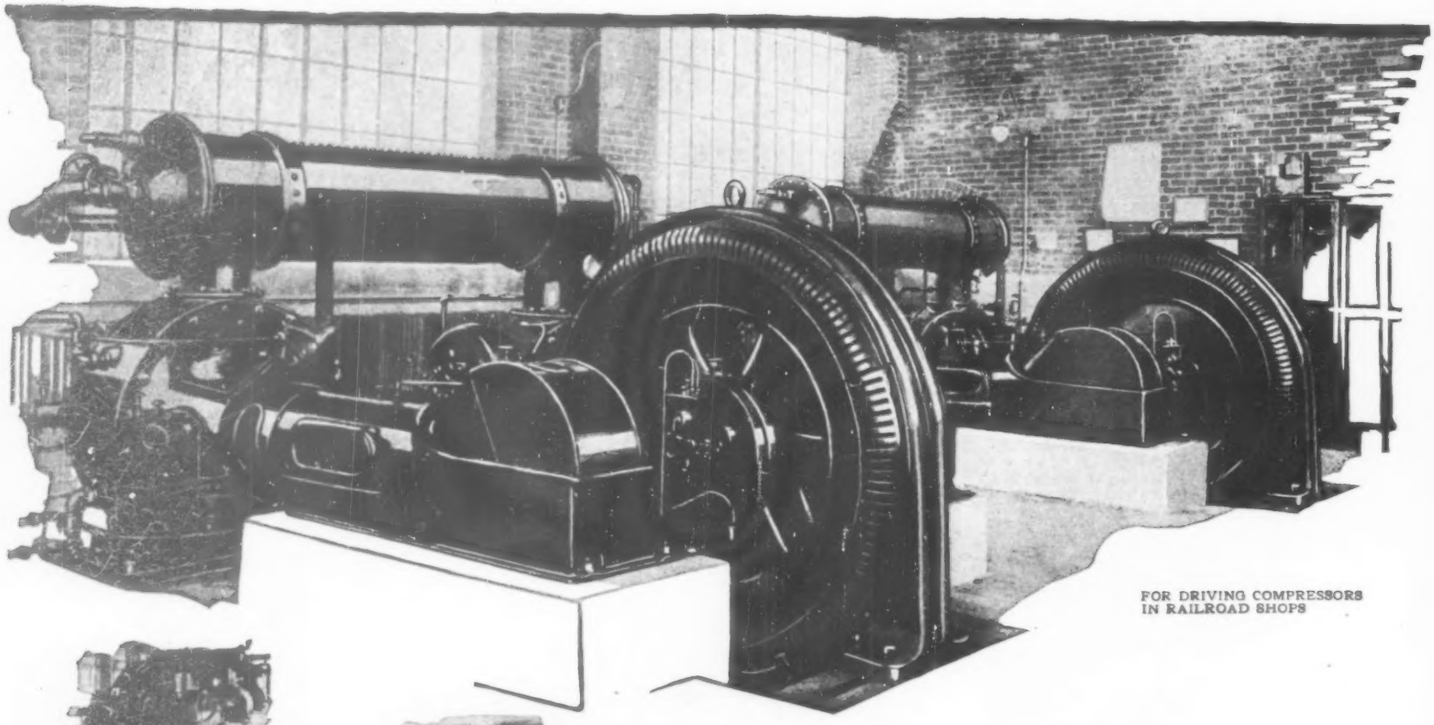
Many users of electric power keep pace with industrial advancement by judicious application of motors which "keep step" with the current generator



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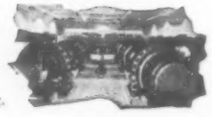

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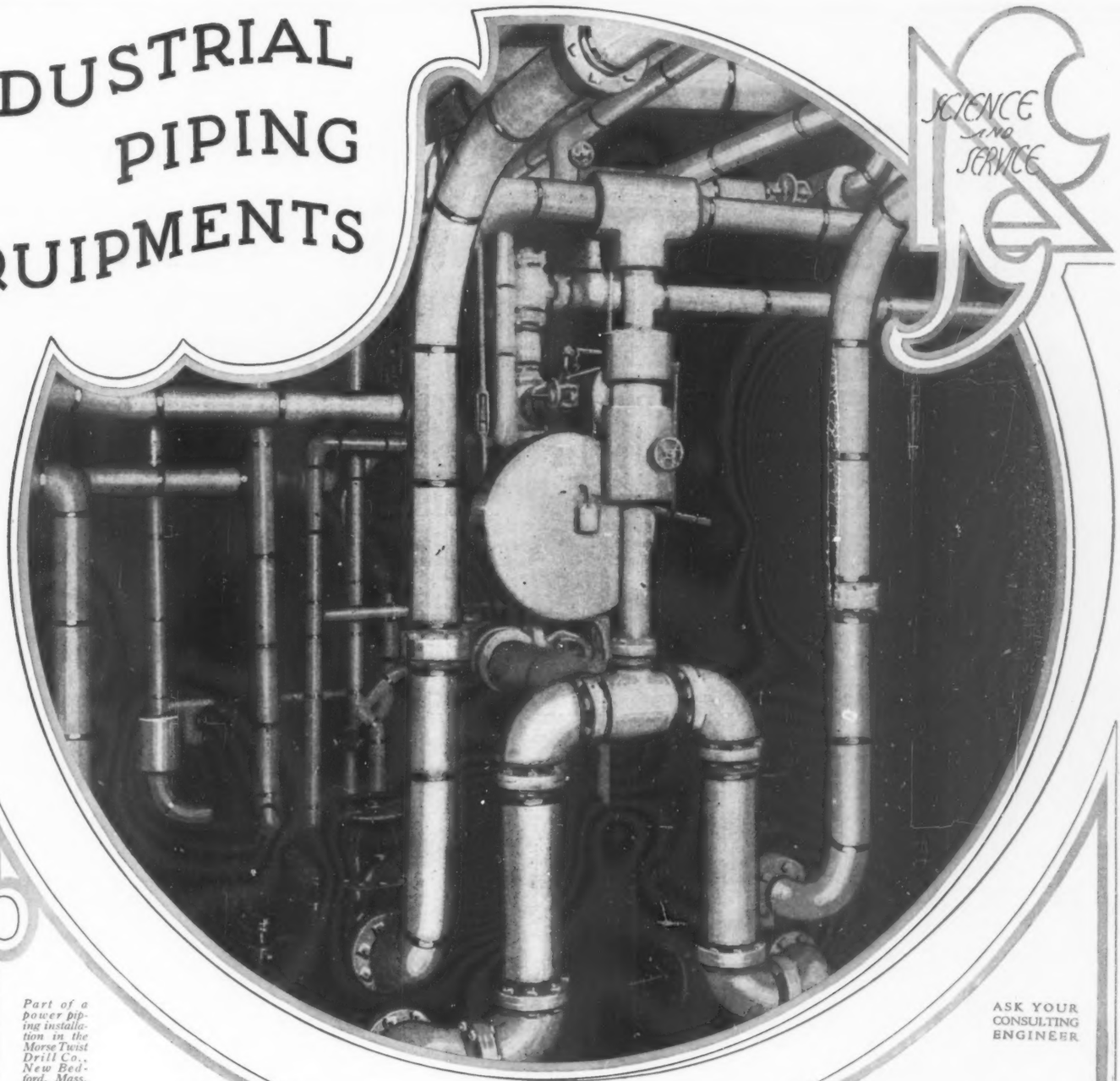
SCIENCE AND SERVICE



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XUM

SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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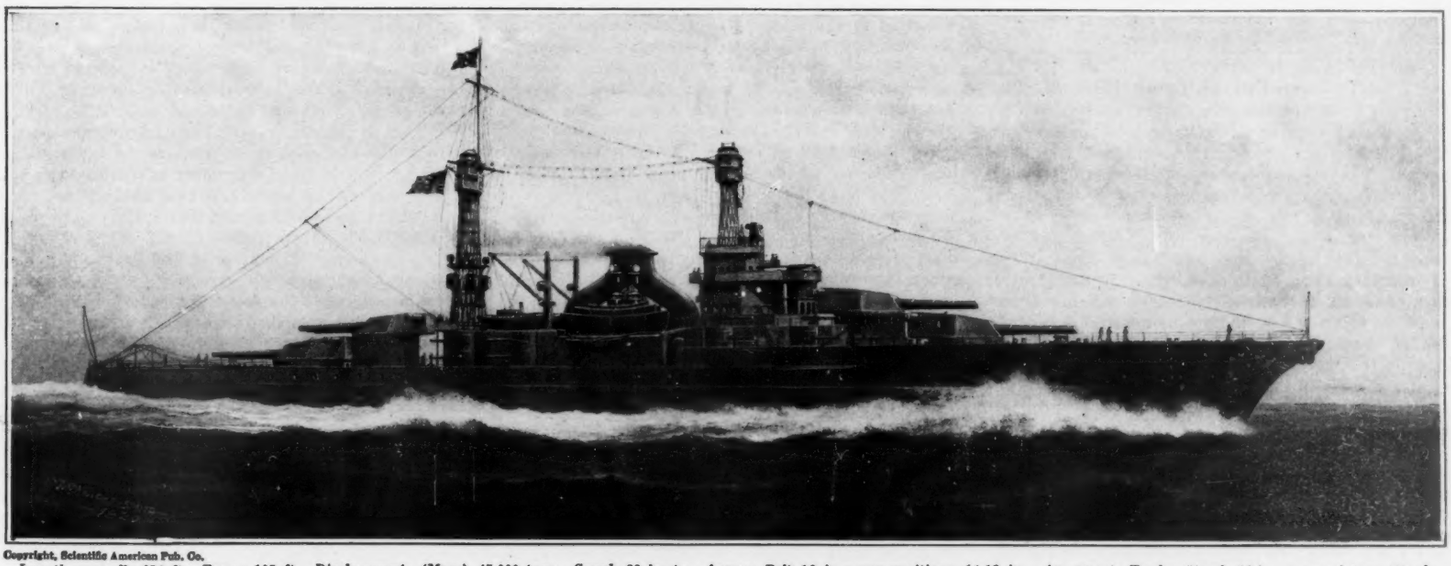

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Length over all: 684 ft. *Beam:* 105 ft. *Displacement:* (Max.) 45,000 tons. *Speed:* 23 knots. *Armor:* Belt 16 in.; gun positions, 14-18 in. *Armament:* Twelve 50-cal. 16-in. guns; sixteen 53-cal., 6-in. guns; four 3-in. antiaircraft guns; torpedoes, 2. *Officers and men:* 1,500.

The new "Indiana"—Our latest design of battleship, one of a class of six

The New Battleship "Indiana"

IN our issue of November 13 we described and illustrated the "Tennessee," which, with her sister, "California," will be the last United States battleship to carry as her main armament the 14-inch gun. The Navy Department has done more or less work upon our next class, consisting of the four battleships of the "Maryland" type, which will be the first to mount the 16-inch gun. In size these ships will be about the same as the "Tennessee." The principal difference will be that they will mount eight 16-inch guns in four 2-gun turrets instead of twelve 14-inch guns in four 3-gun turrets. The names of the vessels of this class are: "Maryland," "Colorado," "Washington," and "West Virginia."

The fine illustration shown above represents the latest class of battleships to be designed by our navy. Six of them are proposed, namely, "Indiana," "Iowa," "Massachusetts," "Montana," "North Carolina" and "South Dakota." As it will be evident from the details given below, these will be the largest, most heavily protected, most heavily armed battleships that have yet been designed for any navy. The length between perpendiculars will be 600 feet, and the length overall, 684 feet. For the first time in our navy, the beam will exceed 100 feet, the exact measurement being 105 feet. This is the practicable limit, as determined by the usable dimensions of the Panama Canal, which has a clear width in the locks of 110 feet. It will be seen that there will be a clearance of only 2½ feet on each side when one of these vessels makes the passage of the canal locks. The mean draft will be 33 feet and the normal displacement with a two-thirds supply of stores and fuel and a full supply of ammunition on board will be 43,200 tons. The full load displacement will be in the neighborhood of 45,000 tons. The motor power consists of twelve White-Forster oil-fired boilers and two sets of Westinghouse turbo-electric drive, and the current will be generated in two main generators and distributed to four motors on the four propeller shafts. The estimated horse-power on trial or, to be more accurate, the shaft horse-power is 60,000 and this is expected to give the ships a trial speed of 23 knots.

Particular attention has been paid in these ships to the protection of their stability and flotation. To safeguard against torpedo attack below water, the space between the outside skin of the ship and the interior hull containing the magazines, boiler rooms, engine rooms and steering gear, is divided by several, continuous, watertight, vertical walls or bulkheads of steel, which extend unbroken practically from end to end of the ship. The bottom edge of these bulkheads is riveted to the inner floor of the double bottom. The upper edge is riveted to the under side of a heavy steel protective deck, located at the water line. Intersecting these longitudinal bulkheads at frequent intervals are transverse bulkheads, which extend from the outer skin of the ship to the bulkhead enclosing the engine and boiler rooms, magazines, etc. Thus, the whole of the elements of the "Indiana" which are essential to her proper functioning both as to speed, maneuvering and fighting, are surrounded by a vast multi-circular, watertight, and immensely strong steel cofferdam which, it is believed, is so efficient that the new "Indiana" can take the blow not only of one but of several torpedoes without being sent to the bottom. Coupled with this is an exceedingly powerful pumping plant with connections which would enable any portion of the ship to be drained of inflowing water. So much for the anti-torpedo protection.

For protection against gunfire, the "Indiana" carries a belt which extends from well forward on the foremost turret to well aft of the after turret, and reaches from several feet below the waterline up to the gun deck. The thickness of this armor has not been disclosed. It is not less than fourteen and may be sixteen inches. The protection to barbettes and turrets is on the same generous scale. Associated with this side armor are several steel decks, designed to exert sufficient retardation upon plunging shell fire, to set off the delay-action fuses and reduce the shells to fragments before they reach the protective deck.

The main battery of these ships has been planned on the same liberal scale as every other element. It consists of twelve, 50-caliber, 16-inch guns, mounted in four 3-gun turrets. The new 16-inch is an exceedingly powerful weapon. It is about 70 feet in length; it weighs over 130 tons, and it fires a shell weighing 2,100 pounds with an initial service velocity of about 2,800 feet per second. Its maximum range is so great as to exceed visibility from the firing ship, and, consequently, the fire will have to be spotted and directed for these extreme ranges from spotting airplanes flying above the enemy. The firing of these guns will be done upon the director-fire principle. The traversing and elevation of the guns will be determined from fire-control stations at the top of the cage masts, and no longer will the gun pointer stand at each individual gun with his eye glued to a telescope the cross hairs of which he endeavors to keep upon the waterline of the enemy ship. All this will be done by an officer using his single directorscope at the top of the mast. There are two fire-control stations, one at the top of the fore, the other at the top of the main mast. Each has two enclosed decks, the upper deck for the control of the main batteries and the lower deck for the fire-control of the secondary battery which consists of sixteen 6-inch, 53-caliber guns. These guns are arranged mainly in sponsons on the main and on the spar decks. Four are located forward in sponsons, abreast of the foremost and navigating bridge; eight are arranged in superposed sponsons in the after part of the super-structure, and four others are mounted in the open, two on each beam, abreast of the navigating bridge. There will also be four 3-inch, 50-caliber, anti-aircraft guns, and two submerged 21-inch turbo tubes will be carried. At present prices the cost of each of these ships will be over 40 million dollars.

The most novel feature, and one which will readily distinguish these ships from others of the navy, is the curious bifurcated smokestack. The uptakes from the boilers lead two large transverse flues at each end of the boiler rooms, and from the center of these rise two semi-circular, curved smokestacks which are drawn

(*Continued on page 601*)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

To Save Our Shipping Fleet

As a result of the investigation of the Shipping Board operations, the public, no doubt, is by this time pretty thoroughly discouraged, if not disgusted. The revelations of incompetence, extravagance and dishonesty on the part of contractors, climaxed by the statement of one of the Shipping Board's leading officials that no less than two billion dollars has been wasted, is one of the most humiliating disclosures in the whole history of this republic. The mitigating fact, of course, is that the ships were built in wartime as a war measure and under conditions quite unprecedented in the history of merchant shipbuilding. The fate of the war, and therefore of civilization, hung upon the question of our ability to build ships faster than the enemy could sink them. You cannot conduct industrial operations under such conditions and expect to realize the economies which are possible in shipbuilding under peace conditions. This fact must never be forgotten in passing judgment upon the amazing extravagance which marked the operations of the Shipping Board up to the time of the armistice. No such plea, however, can be made in extenuation of the continuance of these conditions in times of peace.

It is futile, however, to repine over the folly and blundering of the past. The question confronting the nation is what to do today in straightening out this enormous tangle. We should lay to heart the outstanding lesson of the whole thing, which is that Government operations of utilities are always extravagantly costly. It was the enormous extent of the Shipping Board's operations that brought this fact home to the public with startling and stunning force. So, the very first thing to be done is to get these ships out of Government control and place them unreservedly in the hands of private operators. They should be sold at once, and when they have passed into the hands of the private owner, he should be left to run these ships according to his own knowledge and judgment.

Long before the armistice, Mr. Hurley, then chairman of the Shipping Board, strongly advocated this policy. Had the ships been sold at the close of the war, when there was an urgent demand for shipping and a scarcity of bottoms to carry the world's commerce, the United States Government could have sold these vessels at the then prevailing high rate, and the loss per ship would have been no more than reasonable. To a certain extent this policy was inaugurated and certain valuable contracts had been drawn up and were practically ready for signature, when proceedings were interrupted by the anti-ally propaganda of a notorious newspaper, and the negotiations fell through.

Since those days the inevitable fall in the price of ships and in freight rates has come about, with the result that the Shipping Board's vessels can be sold today only at an enormous loss, and this at a time when a large portion of its fleet is idle for want of freight.

The investigation above referred to has disclosed that many ships are being operated very expensively and wastefully. There seems to have been no proper system of accounting, a fact of which the grafter or the scoundrel, wherever he has happened to be, has taken the utmost advantage. Matters cannot go on as they are. There is call for instant and sharp decision. If you ask the experienced shipping men of the country, you will find them practically unanimous as to policy. They will tell you that we should sell the ships at once for what they will bring; that they should be sold to experienced shipping companies who will know how to run them to the best advantage; and that the relation of the Government to our new merchant marine should be the same as that which it holds to any great American enterprise—a relation advisory, helpful, and protective.

Our New Army

WHATEVER may have been the differences of opinion on Mr. Baker's policies preceding and during the war, there was a consensus of opinion as to the great ability he displayed in presenting any debated subject—the facility with which he could unravel a complicated question and present it in clear and forceful English. The same quality is displayed in a marked degree in the annual report of the Secretary which has recently come to hand. No one can read this report in full, or even somewhat cursorily, without having a very clear idea as to what has been accomplished in the reorganization of our Army.

Mr. Baker tells us that the Army is essentially a new army, not merely another army from that which existed prior to the war, but new in its attitude toward the country and the country's attitude toward it. He claims that the extent to which a new era has dawned for the Army is shown by the results of the Army recruiting. We are assured that the difficulty in securing the necessary enlistments for our small prewar army has in large part disappeared; and, although the stimulus of the active operations of war has now entirely disappeared, the total strength of the Army on November 3, 1920, was 213,067.

We are not surprised to learn that the one-year enlistment period which was authorized by Congress has failed to give results, and that from the point of view of the efficiency of the Army, one-year enlistment periods are of little value. Short term service with the colors, which might serve under a universal training system, in the nature of things can never produce the efficiency which is necessary in the troops of an enlisted regular army. The term of enlistment should be lengthened.

In reviewing the military activities of this country since 1776, the Secretary tells us that, in spite of the fact that the United States is the most peace-loving of all nations, it has been engaged in major, domestic or foreign wars about one out of every four years during that long period. From this he draws the conclusion that while we do not need a great standing army, we must take the world as we find it and try to make it what it should be. Hence, we must have a body of trained men large enough in numbers to be an effective working model upon which great armies could be swiftly built in case of an emergency. A justice-loving people, says the Secretary, may be forced by tragic necessity to resort to war; but it is not right to ask its sons to fight its battles out-armed and out-shielded by their adversaries.

We are told that the War Department in its study of the lessons of the World War has proceeded on the accepted theory, that the infantry remains the backbone of the Army; although at the same time certain other arms of the service were greatly increased in importance by the swift developments of the conflict now past. Fundamental changes in armament have taken place and many of the instrumentalities devised are apparently only at the beginning of their development.

In this connection, we draw attention to the fact that one of our contributions to the development of war weapons was the motorization of artillery and transport. While the allies had done some work along this line, our Ordnance officers worked out a very ambitious system for the complete motorization of artillery up to and including the very largest types of guns. The same thing was being done with transport, and it is our hope that the policy will be followed out. Although it is true that the infantry have maintained their position as the backbone of the Army, it is also certain that the necessity for close coördination between infantry and artillery, not merely field but also heavy artillery, was greatly emphasized on the fields of France and Flanders. The army which possesses the most mobile artillery and transport, other things being equal, will hold a commanding position.

A well-earned tribute is paid by the Secretary to the work done by American women in the war. "All over France during the war," says he, "it was possible to find these serene, dignified, and helpful women; and I know no more knightly fact than that, from the beginning to the end of that great experiment, there is no recorded instance of an indignity or an incivility from a soldier to a woman." This is a fine tribute to the women who served in the various agencies built up around the soldier and his needs.

Why Is A Patent?

THE governmental departments that act as agencies for the collection of the revenue—the customs and the internal revenue—are of course expected to bring in more money than they pay out.

A casual observer would not hesitate to say that no other governmental bureau could possibly be expected to show receipts in excess of expenditures. The Government is not in business for itself or for a profit—it is in business for all of us and for service. Certainly the War and Navy Departments, that supply us with the service of protection, are not to do this at a profit. Surely the Department of Justice does not expect to create a financial profit out of the pursuit and conviction of moonshiners and conspirators in restraint of trade. The Departments of the Interior and of Agriculture and of Commerce and of Labor like to feel that the American people as a whole, through taking advantage of what the departments do for them, save and win sufficient in the course of a year to make the departments a net cash asset to the country at large. But if you asked the Chief of the Bureau of Plant Industry or the Commissioner of Lighthouses or the Director of the Census or the Public Printer why their offices do not show an operating profit, you would get a properly indignant reply.

Even the Post Office, doing business on such a vast scale and at such rates that a profit from operations would seem well-nigh unavoidable, has usually managed to avoid this, and when it has so far transgressed governmental properties as to take in more money than it paid out has promptly made arrangements to remedy this condition by enlarging the scope of its non-profitable services. Here, as in general throughout the Government, the whole theme is to give service—service that shall be profitable to the country at large, and for which the country at large, rather than the direct beneficiary, therefore pays in taxation.

To this benevolent policy, however, there is one shining exception, as pointed out by Mr. William Wyman on another page. The Patent Office, from almost its inception, has been conducted at a direct profit. For some mysterious reason it always is assumed, whenever the needs of this office are being considered, that of course the revenues from the office will meet all the expenses of conducting it, and a little bit more. We wonder what would happen if our courts were conducted on the same principle—if the question of adding a needed member to the Interstate Commerce Commission or bringing the salaries of the Justices of the Supreme Court up to a proper basis was made to depend upon the extent to which additional funds might be obtained through a revision of court fees and fines?

The fundamental fallacy seems to be that the Patent Office is selling something to the people with whom it deals, and that they must pay the cost of that thing. We have exposed this fallacy often, and shown clearly that the whole position of our country in the world depends upon the supremacy maintained by our inventors in spite of every discouragement.

The Patent Office is not selling goods to inventors. It is granting to inventors what is theirs by virtue of a provision in the compact known as the Constitution of the United States. If it is intended to withdraw this as a right, and replace it by a privilege to be sold only to those who can pay for it, let us come out in the open and amend the Constitution; let us state explicitly that, like France, we regard the inventor solely as an object of taxation and after we have got out of him all we can, do not care what becomes of him. If it is not intended that this be the basis of our patent system, let us put the Patent Office on a footing of equality with the rest of the Government.

XUM

Naval and Merchant Marine

Italian Flotilla Leaders.—In the opinion of some authorities, the latest Italian flotilla leaders to go into commission are the most powerful in the world. With a displacement of from 1,900 to 2,200 tons, they are comparable to the British "Scott" class. Three of the boats mount three 6-inch and four 3-inch guns, and the fourth carries six 4.7-inch guns, which may be compared with the armament of five 4.7-inch guns in the latest British fotilla leaders. The contract speed of these boats, 35 knots, has been exceeded.

Improved Gunnery in the Navy.—Analysis of the gunnery exercises of the American Navy during the past year shows that the greatest progress toward efficiency was made by vessels of the battleship class, due to the larger number of men aboard such ships and the comparative stability of the personnel. The Navy Department considers that battleship gunnery is at present about equal to that of foreign battleships. It is believed that next year vessels of other classes will be brought up as regards gunnery to the level of our battleships.

The Minimum Requirements of the Modern Dreadnaught.—Speaking editorially the *Naval and Military Record* says that British naval opinion is almost unanimous as to the material elements which qualify a capital ship for the first rank. These are: First, a main battery of not less than eight guns nor of less than 15-inch caliber; second, for battleships, armor protection that will resist the heaviest armor-piercing shell at ranges exceeding 12,000 yards; third, an all-round bulge defense against torpedoes; fourth, for battle-cruisers a sea speed of not less than 30 knots.

British Dominions and Navy Policy.—The various British dominions, and particularly Canada, New Zealand and Australia, are giving much attention to the question of naval defense. There is a tendency to muster out the older units and keep in commission only the latest types of warships. The question of future increases is awaiting the decisions of the Meeting on Imperial Defense, which will be held next year, at which all the dominions will be represented. It is likely that the plan of imperial defense drawn up by Lord Jellicoe will be accepted with certain modifications.

Monument to Dewey at Manila.—Rear Admiral Casey B. Morgan, Commandant of the naval station at Cavite, P. I., in a letter to the governor of the Philippines, refers to the absence of any monument or public improvement in the city of Manila bearing the name "Dewey"; which lack of suitable civic recognition has been a matter of wonderment and amazement to him and to other officers who have been associated with these islands since the earliest days of our occupation. It is amazing that such neglect of the deeds of this great naval officer should exist.

Admiral Benson to Masters of Ships.—Admiral Benson has recently made public a message to all seafarers of the merchant marine, in which he draws attention to the reduction in ocean freight movement and makes an appeal for a spirit of coöperation under the present conditions, so that foreign competition may be successfully met. He urges masters and chief engineers, port captains and port engineers "to take the utmost interest in the operation and proper repair of the vessels in their charge." He urges them to keep their ships in seaworthy condition, to effect quick turnaround, to reduce the cost of repairs, and avoid overtime. He reminds them that without such increase in efficiency an increasing number of vessels must be tied up.

Battleship Versus Torpedo Plane.—Commenting on certain articles by "Quarterdeck" in the *New York Tribune*, in which the abandonment of the superdreadnaught, if not the dreadnaught itself, was advocated, Rear Admiral Fiske says that most of the men who oppose the strenuous development of aeronautics have not carefully studied its possibilities. He agrees with "Quarterdeck" that this is the time to "stop, look, listen," and study thoroughly the possibilities of the new art. He believes with many others that aeronautics is destined to bring about "a revolution in warfare, in comparison with which the revolution brought about by the invention of the gun was like a vaudeville performance." Pretty strong words these for an admiral! At the same time, no naval man is better qualified to speak on this subject. Admiral Goodrich writes to the same paper that if he understands "Quarterdeck," this is the moment for careful investigation, for which ample time exists. He believes that it is not the time for continuance and enlargement, and the present building program may be found to be unwise.

Astronomy

The Laws Observatory of the University of Missouri, erected in 1853, has been torn down, and a new building is being erected to replace it about half a mile south of the former site.

Periodic Variations in the Brightness of Jupiter, due to the different markings presented to us in the course of the planet's rotation, though necessarily very small, are within the range of observation of the photo-electric cell. At the Berlin-Babelsberg Observatory P. Guthnick found by this means last December and January a variation having an amplitude of 0.14 magnitude. This variation had, however, diminished to 0.04 magnitude a month later.

The Warner and Swasey Observatory.—On October 12, 1920, occurred the formal dedication of the fine observatory presented to the Case School of Applied Science, Cleveland, by the Warner & Swasey Company, and called in honor of the donors the "Warner and Swasey Observatory." An address was delivered by Director Campbell, of Lick Observatory. The new observatory contains a library and a full instrumental equipment, including a 10-inch refractor, of which the object-glass was made by Brashear and the mounting by Warner & Swasey.

Warner & Swasey.—The name of this American firm of telescope-builders is a household word among astronomers, who will be glad to add to their libraries a booklet which the firm has published on the occasion of its 40th anniversary, giving a history of its development from the usual small beginnings. Many astronomers will be astonished to learn that telescope-making is almost a negligible fraction of the business of this great establishment, the chief product of which is the turret lathe. Similarly, meteorologists who visit the "Belfast Observatory" factory of Messrs. Julian P. Friez & Son, in Baltimore—remarkable for its architecture and appointments, as well as for the work done there—are usually much surprised to discover that the making of meteorological instruments is a side issue in the business of the concern.

Longitude Determinations by Airplane.—M. Paul Ditisheim has recently published the results of his latest experiments in determining differences in longitude by means of chronometers carried in an airplane; the experiments in this case having been made in May, 1920, between London and Paris. Twelve small "deck watches" were used in the experiments, after having undergone rigid tests at the National Physical Laboratory and at Greenwich Observatory and having proved to be of exceptional accuracy. These were carried 5 times by airplane between the English aerodrome at Croydin and the French at Le Bourget, the trips between the aerodromes and the observatories of Greenwich and Paris, respectively, being made in automobile. On these journeys the time-pieces were carefully packed in a valise, which M. Ditisheim, with the aid of a spirit level, maintained in a horizontal position. Corrections were applied for temperature and altitude. The mean result of all the determinations was 9 m. 20.947 s., while the mean of the best previous determinations by other methods is 9 m. 20.952 s.; in other words, the airplane method gave a result for the difference of time between London and Paris differing only .005 second from the standard value.

Nova Cygni No. 3, which was of magnitude 3.5 when discovered by Denning on August 20, 1920, and rose to a maximum brightness of 1.8 on August 24, remained visible to the naked eye for less than a month. It is gratifying to record that members of the American Association of Variable Star Observers obtained 287 observations of the brightness of this star, covering every day of the month during which it was a naked-eye object, and, at first, almost every hour. Early in November the star was still visible in small telescopes, being of about mag. 9. The history of the star before August 20 has been published by M. Felix de Roy in the *Observatory*. It is not found on a photographic plate taken June 3, 1905, which shows stars down to the 16th magnitude, nor on a plate of the same region taken July 20, 1920, showing stars down to the 11th magnitude. A Harvard plate taken August 9, 1920, including stars down to the 9th magnitude, does not show the nova, but appears as a 7th magnitude star on a plate taken by Nils Tamm, in Sweden, August 16, and as a star of mag. 4.8 on a Harvard plate taken August 19, the day before its visual discovery. M. de Roy calls attention to the fact that novæ have, of late, been more plentiful than comets, and that four of these objects are now visible in telescopes of moderate aperture: viz., Nova Cygni No. 3, Nova Aquilæ No. 3, Nova Lyræ and Nova Ophiuchi No. 4.

Engineering

More Power from Water Resources.—A large hydroelectric plant of 20,000 horse-power has recently been completed by a French hydroelectric company. The new plant is located at Seyssel, Haute-Savoie. Importance is attached to the completion of this project because of the present scarcity and high price of coal, and likewise because of the effect it will have toward encouraging similar undertakings in France. The new plant is equipped with four turbines, each capable of developing a force of 5,500 horse-power. It is proposed to install another turbine at an early date, and thus increase the production to 27,000 horse-power, an amount that equals almost one-third of all the energy consumed under different forms by the city of Lyons.

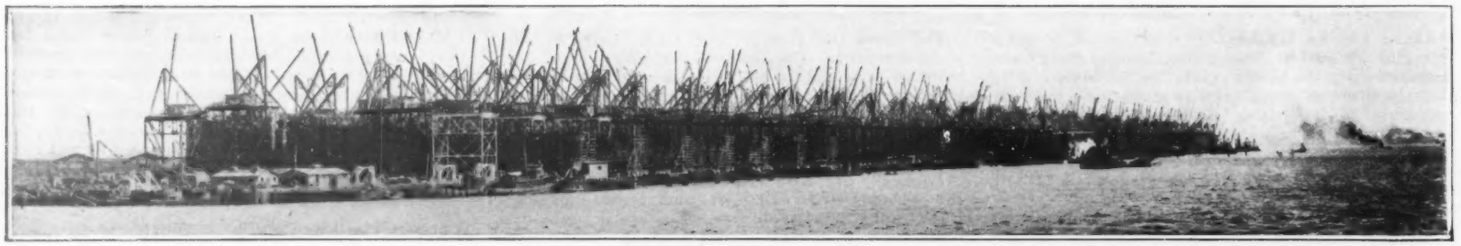
Pressure of Concrete on Forms.—A pressure-gage devised by A. T. Goldbeck and used for the last few years in measuring earth pressures behind retaining walls and under fills, has been applied successfully to the measurement of the pressure of concrete on forms embedded therein. The gage consists essentially of an air-tight metal cell having a circular weighing face 10 sq. inch, in area, according to the *Engineering News-Record*. The concrete pressures against the face of the cell are balanced by admitting compressed air to the inside of the cell. When the pressures are balanced an electrical contact is broken which extinguishes a light and signifies that the pressure shown on the gage connected with the air pipes is equal to the pressure of the concrete.

Making the Most of Natural Reservoirs.—From Australia comes the news that Torrumbarry weir will immediately serve an important purpose. At the present time large areas in Victoria are served by natural reservoirs known as the Kow Swamp and the Leraag Lakes. When the Torrumbarry weir is completed the level of the river will be considerably raised, and it will become possible to replenish these natural reservoirs when desired. Another important work contemplated at an early date is the construction of a weir for the diversion, when necessary, of waters into Lake Victoria. This lake provides one of the finest natural storage basins along the whole length of the river. The object here will be to fill this basin during times of plenty and then, as the river later recedes, to discharge its contents back into the river for the use of the settlements in South Australian territory. Thus the water instead of being allowed to escape will be regulated to suit the requirements of the irrigation settlements.

Concrete in Cold Weather.—This is the time of the year, says *Engineering News-Record*, when warnings about frozen concrete should be more freely given. When it is definitely and continuously cold only the most ignorant and careless will attempt to make concrete and remove forms without due respect for freezing, but now the warm mid-day is apt to make the constructor forget the cold mornings and cold nights which retard setting just enough to reduce strength below the safe limit. An added warning may be worth while. The only certain way to insure against cold weather in concreting is to provide heat—heat in the aggregate and in the water and heat in the structure during the setting period. There are chemicals which lower the freezing temperature of concrete, but their advantage is indeterminate and at best small. Little dependence can be placed on them as a total defense. They may serve as a partial defense when temperature reductions are small, but if their use leads to neglect of more certain precautions they inspire an unwarranted confidence.

Maintaining the Dirt Road.—There is little local stone in the Canadian province of Saskatchewan, hence the question of roads resolves itself into importing supplies at a considerable expense or resorting to dirt roads. As far as rural roads are concerned, the cost of the former practice is prohibitive, and the dirt type has been widely adopted. Recognizing the limitations of an earth road with regard to the permanency of its surface, the question of providing a serviceable earth road becomes largely a question of maintenance, and because of the quick deterioration of such a road, especially in wet weather, its maintenance must be continuous. This, we are told by the *Road-Maker Excavator and Grader*, can be accomplished effectively and cheaply by a proper use of the road drag. The work has to be done repeatedly, and, although there is little improvement to show for two or three draggings, a season's work gives manifest results, and the improvement continues with each successive season that the dragging is kept up. The work in Saskatchewan has been encouraged by the institution of an annual competition. The average cost of road dragging in 1914 was $6.28 per mile; in 1919 $9.04 per mile.

XUM



General view of shipways, looking northeast from main wharf. There are fifty shipways at Hog Island

The World's Greatest Shipping Terminal?

Or Will Hog Island Merely Stand as the Record Junk-Pile of All Time?

By William Benjamin West

ADVERTISEMENTS appearing in the daily papers recently indicated that Hog Island is on the market. We have seen what happened to other items of war-time salvage of which the Government countenanced the dispersal or sale. But Hog Island, it seems, ought to stand in a class by itself, as the one by-product of the war which possesses inestimable value to the American people. Whether it is sold or not, every precaution ought to be taken to see that it remains in use to the greatest possible extent of its vast capacities.—THE EDITOR.

THE plan of building fabricated ships had been advocated by leading engineers for years, and when it was found that we were compelled to have ships built within a short time, the construction of ships in this way seemed the only thing to try. But existing yards were not adequate and a new yard had to be built.

Through authorization from the Federal government, a careful investigation of all the proposed sites for a plant was made. After considering the different prospective places, Hog Island, a barren waste of land about 10 miles from City Hall, Philadelphia, was finally selected for the largest of these yards.

The main aim was to build ships, build many and build them quickly, for our country was needing them, and needing them badly, so nothing was spared. What can be seen now at that shipyard is evidence that something must have been going on there during our time of belligerent activity. Approximately 35,000 people were employed in the construction of the plant. Personal observation as to the organization and detail that is carried out at present, even though the war is now over, leaves the impression that the operation of the yard was carried out as efficiently as could have been done under the trying circumstances.

From a barren island of waste land in the summer of 1917 to the largest shipyard in history one year later, in spite of the terrible weather conditions encountered, and almost unsurmountable difficulties overcome, is a record seldom if ever equaled in the history of American industry. And Hog Island has continued to build ships after we withdrew our forces from France and the records show that her trend of efficiency has constantly been upward ever since the present management took charge.

After the first ten ships were constructed the unit cost continued to decline and finally the latter part of the programme was completed at considerably below the unit cost and in a part of the time spent on the first lot of ships. However, it is not for the writer to either uphold or criticize certain phases of the work at Hog Island in this article, but rather to describe certain interesting features of its construction and outline the general plan of operation.

The original area of Hog Island was 846 acres. The purchase price of this tract was $1,706,000. In 1918 an addition of 81.14 acres was made to this by the purchase of what is known as the west impounding basin at the west end of the original property on the water front, for the purpose of pumping from dredging in the wet basin.

With the construction program fully completed, there are 50 shipways at Hog Island. They are divided into 5 groups of 10 ways each. The total area of the 50 ways is 1,529,560 square feet. Some of these ways are of wood and some of concrete construction. The piers between ways are 37 feet wide and vary in length from 132 to 324 feet. There is a wide pier between each group of 10 ways which is 142 feet wide. The total area of the ways and piers is 442,193 square feet. There are 7 piers 100 feet wide and 1,000 feet long (on the short side of the pier) in the wet basin. It is these piers which certain authorities are recommending for use as a terminal at Philadelphia after the closing down of the shipyard. These 7 piers which are used for outfitting the ships after they are launched have a total area of 747,271 square feet.

The administration buildings, office buildings on ways and elsewhere, have a total area of 1,200,000 square feet. The utility buildings, fire houses, electric substations, guardhouses, water stations, etc., have a total area of 150,000 square feet. There are 90 acres of steel storage yards, 58 acres of equipment storage yards, and 5 acres of coal storage yards. The total area of all these yards is 153 acres.

There are two separate and distinct water systems at Hog Island, a high-pressure system for fire protection and industrial use, and a domestic system for drinking water, etc. The high-pressure system consists of two pumping plants. The capacity is 19,000 gallons per minute; normal pressure 62.5 pounds; fire pressure 125 pounds (with pumps connected in series). There are 270 hydrants and 86,000 feet of piping from 2 to 16 inches in diameter.

The domestic system consists of one pumping station and one filtration plant. Its capacity is 2,000,000 gallons per 24-hour day. The source of both systems is the Delaware River. The filtration system is the rapid sand gravity type through which water is sedimented, filtered, and chlorinated. This system has a storage capacity of

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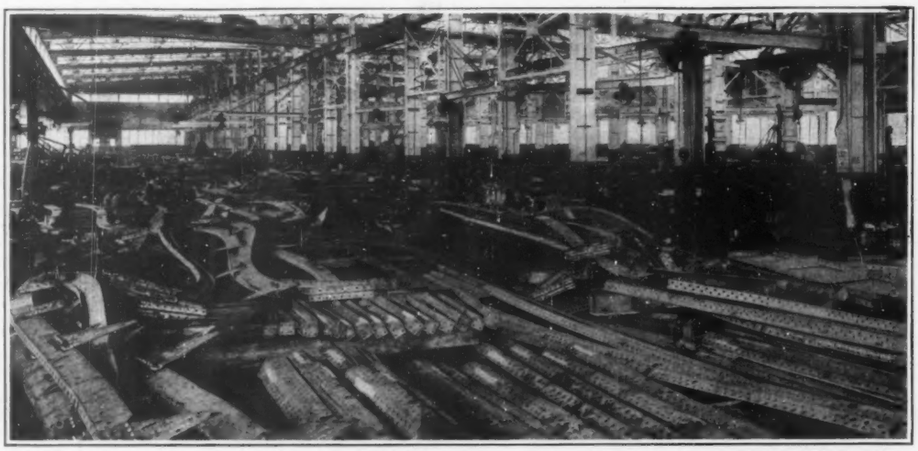

Looking through the center bay of the plate and angle shop, showing the great manufacturing possibilities of the Hog Island plant

Bird's-eye view of the Hog Island shipyard, showing the wonderful terminal facilities of this plant. The fifty ways are seen in the upper right-hand corner

From Wood to Cloth

By Samuel J. Record
Professor of Forest Products, Yale University

CLOTH made from wood is of interest in this country chiefly because of its novelty. A few suits of "wooden" clothes have been imported from the Central Empires and during the "over-all campaign" against the high price of wearing apparel considerable attention was devoted to them because of their cheapness.

Low first cost is about all that such clothes have to recommend them, except as a passing fad, or in times of great emergency when cotton, wool and other standard textiles are wanting. Germany experienced such an emergency and wood-paper textiles proved to be better, very much better, than nothing. The users of such material came to it with suspicion and, for the most part, had as little to do with it as possible. The principal objection to it was that it wouldn't wash and the objection was well founded, especially at first.

Wood is a fibrous material and its essential constituent is the same as that of cotton, namely cellulose, though not in nearly so pure a state. The Germans were able to purify wood cellulose, however, and use it as an acceptable substitute in the manufacture of gun cotton. Wood has also been used for years in the manufacture of artificial silk, an industry which has become of very great importance. In the latter use as a textile material, all trace of the fibrous structure of the wood is obliterated and an entirely different substance is obtained.

It is a comparatively simple matter to reduce wood to its component fibers since the cementing substance that holds them together is readily dissolved by certain acids and alkalies without material injury to the cellulose of the fibers. In spruce wood the length of fibers varies from one-tenth to one-fourth of an inch with an average of about one-eighth of an inch. In some other woods they are a little longer or a little shorter, but apparently too short for spinning directly into yarn or thread, though the Germans claim to have devised a method for doing it. The usual way is to convert the fiber into paper and then spin paper strips into yarn.

In paper-making wood is reduced to fine fibrous pulp, which is felted together into a sheet and ironed down. Different kinds of paper vary enormously in their strength, toughness, resistance to wetting, etc. News-print paper, which is very weak and brittle, is made mostly of ground-wood pulp, that is, the wood is reduced to

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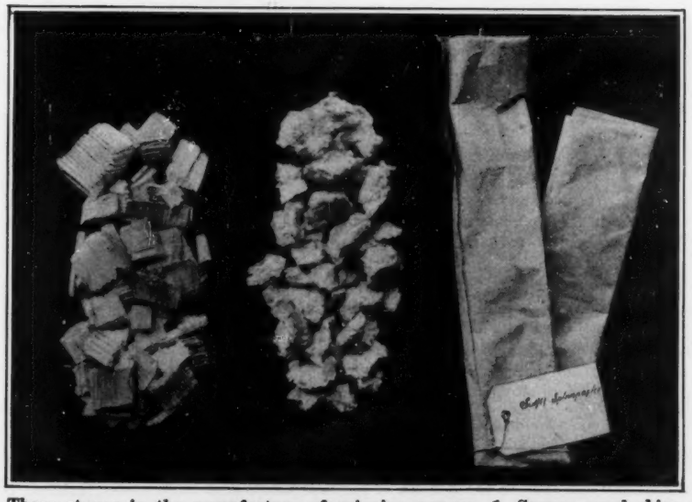
A 60-foot Burden water wheel at Troy, N. Y. A giant among water wheels and a symbol of the era preceding the hydraulic turbine



Three stages in the manufacture of spinning paper: 1. Spruce wood chips. 2. Spruce wood pulp made by cooking chips in acid. 3. Spinning paper made from the wood pulp

A Giant of Old

By J. Flagler Wright

THE modern turbine water wheels differ from old-time water wheels particularly in the fact that the new machine receives power water around pretty much the whole of the circumference, whereas the old style wheels received it either at a single point or else through a limited arc. No doubt, the extension of the region of application of power water is a principal factor in the efficiency of the more recent appliance. However, the old wheels deserve our respect. It is also possible that they embodied features which are capable of development under present-day circumstances.

One of the most notable of the old machines was the old Burden Water Wheel at Troy, N. Y. This fellow was the greatest of all American water wheels belonging to the period preceding that of the hydraulic turbine. The diameter of this giant was about 60 feet. It was of the over-shot type. That is, the water impinged on or near the summit of the wheel. There was a central hub to which 264 iron rods were attached. These extended in approximately radial directions, somewhat like the spokes of an ordinary carriage wheel. These were, at their outer ends, secured to the wooden rim.

Unlike a good many water wheels of the older time, the Burden wheel did not exert its drive through a central, or axial, shaft. Instead, the drive was effected on the two sides near the periphery. That is, a gear rim of the spur type was arranged on the two sides of the water wheel. The diameter of each was 56' 4"; so that the drive was effected by wheels almost as big as the water wheel itself. This arrangement of peripheral drive eliminated torsion troubles with the main shaft. By using what was in effect a big spur gear on both sides, the wheel was stressed evenly. The big gears each meshed with a small spur gear on a shaft. The shaft was arranged in front of the face of the great wheel and about half way down between the level of the center and the level of the bottom. On one side, the shaft was prolonged greatly. At the end was mounted a big spur gear called the bull wheel. It meshed with a small gear on the same shaft with a 20 foot flywheel. By means of a bevel gear turning with the flywheel and a second bevel gear on a long main shaft, the latter was rotated. This mainshaft, as perhaps the reader has already surmised, was set at right angles to the axis of the water wheel.

The water to drive the wheel was

(*Continued on page 602*)

Left: Ribbon of paper which is to be spun into paper yarn. *Center:* Miscellaneous paper cloths. On top is a wall covering. Beneath in the order shown, are bed sheeting, work clothes, curtain goods, and sail cloth. The coarsely woven goods beneath are rugs and hall runners. *Right:* Paper textiles, twine, rope, shoe laces, braid and harness straps.

Paper ribbon for making paper yarn and some of the paper products which are finding their way to our markets

The Needs of the Patent Office

Results of the Insistence that This Most Vital Government Bureau Pay an Operating Profit

By William I. Wyman, Chief Clerk, U. S. Patent Office

THE imperative need of the Patent Office is a new attitude. The argument that has most been used to obtain support for its requirements is that it pays a profit into the Treasury. That the Office makes a profit is conclusive that the inventor is being deprived of something due him. But the fact that should be of the most significance is that the Office, as the center of the patent system, is a vital factor in the industrial progress of the country; and its needs should be treated with that consideration solely in mind. The general government pays out scores of millions of dollars for education, scientific research, promotion of agriculture, publications of more or less cultural value, and for various like purposes. But for the medium that is the most direct incentive for increasing the industrial capacity of the people, the government sees to it that it does not spend a red cent. In fact, it plays safe by assuring to itself that the Patent Office shall always be conducted at a profit.

The obvious and more immediate needs of the Patent Office are more room, better equipment, and a larger and more adequately paid force. The building is crowded to-day. There is practically no room for the expansion for the business and the records. The examining divisions are jammed, the files occupy every nook and cranny of the building, the clerks do work in close and uncomfortable quarters, and the library, search and record rooms are filled to capacity. Immediately there should be planned provision for a new building or for enlarged quarters. Even if more room were authorized at once, the pressure of constricted space would become critical before the additional accommodations could possibly be made available. The necessity for quick action is, therefore, very plain—the penalty for delay very apparent.

The equipment of the Office is antiquated and insufficient. The furniture, filing cabinets and shelving, and general office appliances are about the worst in the government service and require modernization and extension. This is particularly true of the storage of copies of patents, the Scientific Library, the records in the manuscript and assignment divisions, and the files throughout the Office.

The clerical force is at present inadequate to do the business of the Office. A 15 per cent increase in numbers with a fair advance in salary to hold and acquire good personnel material would be sufficient to relieve the present unsatisfactory status. As for the technical corps, (the examining service of the Office) a much larger increase in numbers than is provided in the Nolan Bill, now in conference, is desirable if any permanent improvement is to be secured in the character of the examination. If more than a fair scrutiny of the art is to be observed, if something approaching a critical examination of the vast printed records of the advance in industry is to be undertaken, the field of search must be much more limited to the individual examiner and he must be given much more time to study the records and make up his decisions. Especially is this the case in the more technical arts, such as the chemical, electrical and process departments.

It goes without saying that the rapid overturn of the scientific men in the Bureau is disintegrating and disruptive in the highest degree. Any advance in salary that would retain a substantial percentage of the large numbers who now resign to receive greater compensation in private practice would save the industries of the country many fold the advance in pay. At present, this is the most disturbing situation in the Office, but may be remedied if the Nolan Bill (referred to above) passes Congress in its original shape.

These are the most obvious inadequacies and they require immediate remedial treatment if the Office is to perform its most elemental functions with even a minimum amount of satisfaction. Failing this, in any particular, the public must face a continuance of the irritating, insufficient, dilatory and costly conditions which now entail such a needless hazard upon American industrial progress.

The requirements just specified are those necessary for merely carrying on the ordinary functions of the Office in accordance with the accepted standards of the last two generations. To correct the glaring deficiencies so enumerated would merely give the public the service it normally expects and is entitled to. These urgent needs attended to, the public would then receive expeditious responses to their inquiries, and the aggravating and inadequately paid force and poor equipment would be corrected. But the usefulness of the Office is far from being limited by the installation of these merely remedial measures. It can multiply its effectiveness immeasurably through its extension of its functions and changes in its methods.

The Office to-day lacks effective organization. There are 60 or so divisions, about 50 being technical and the remainder clerical. The Commissioner is in direct control of the technical divisions and exercises his administration of the clerical divisions through the Chief Clerk, who, in turn, shares with the primary examiners the control of the clerical personnel in the examining division.

It is utterly impossible with this arrangement for the Commissioner to have an intimate knowledge of the conditions existing in the many units into which the Office is divided. For purposes of administration and to make the actions of the examiners more uniform (now so objectionably diverse) it would appear to be decidedly advantageous to combine the divisions into groups. The associated divisions could be grouped to accord with the related arts. Questions of assigning of applications, simplifying the search, associating the related literature and making available the technical and legal knowledge of the corps, could be more readily disposed of. The files could be kept more systematically and the clerical and messenger work be made more elastic to accord with any change of condition. The executives of the Office could exercise a more intelligent and intimate control over the actions of a small number of large divisions than over a great number of diversified and small units. And that such intimacy of control is needed is well known to all observers and is in accord with general experience.

Another defect in the organization is the mixture of functions exercised by the Commissioner. He is at once the administrative and legal head of the Office, and as the duties in both capacities are heavy and involved, one or the other suffers in their exercise. Without a change of method, such a sacrifice of one of his dual rôles is inevitable. The writer's suggestion is to lodge the entire *active* administration in the hands of the Commissioner and to control the legal program of his office by requiring the Assistant Commissioners, who shall hear *all* cases that come up to the Commissioner on appeal, to report and obtain his approval of all decisions that involve a commitment to any change of legal policy or radical legal action. Those cases that involve the substitution merely of the appellate tribunal's judgment in place of that of the tribunal below could all be tried and decided by the Assistant Commissioners. Only such decisions which would commit the Office to a new course of procedure, or which would constitute leading cases should be referred to the Commissioner for his approval or criticism. Such decisions should be published over the name of the Commissioner and they would comprise the means by which, without undue expenditure of time and labor, he could thoroughly exercise his legal control and leave time for the execution of any administration program, no matter how involved or ambitious.

Inseparably connected with reorganization is adequate room, effectively rearranged to carry forth any advanced scheme. To execute the group plan, to provide that there shall be no lost motion in the movement of the work, to assign and locate responsibility in the duties to be performed, and to bring the clerical divisions into efficient coöperation with the technical departments and into effective relationship with the public require a structure planned on radically new lines. Subsidiary to this, but dependent upon any new plan of building devised, is that of equipment. The means for storing the records and files and for transferring messages and papers could, if comprised of modern appliances, provide for tremendously better service in the way of expedition and accuracy. Especially is this so in the matter of storage of printed copies of patents. These should be placed in a central location according to the stack system, in compact arrangement and in connection with devices to provide accurate placement and quick deliveries.

Without a permanent force no reorganization, no reequipment, will be sufficient. It goes without saying that adequate salaries should be paid to avoid a constantly shifting personnel. It is not too optimistic to hope for such a development in public opinion as will abolish politics in the appointment of the Commissioner. With a comparatively fixed personnel, it is possible to develop an administrative policy and to increase the usefulness of the examiners to any reasonable degree. That deep knowledge of an art that comes from extended practice therein could be made available to the public by such means as the compilation of card indexes, or the publication of brochures on various phases thereof (to mention only a few suggestions that come to mind). With a staff of men attached permanently to the Office, it would be a good investment for the public to assign them at various times to inspect and "live" with the industries in order to acquire the "atmosphere" of their arts and a practical point of view. With a permanent and adequate force of scientific and enthusiastic men, there is almost no limit to the extent of valuable service they could render to the industries of the country.

Another highly desired consummation is the completion of the reclassification and a rapid review of it after completion to iron out inequalities and inconsistencies. Once that is done, and the classification fairly standardized, it is possible to brief the inventions and publish abridgments of them, as is done by the British Patent Office. Or patents unabridged could be bound in classified arrangement and form valuable compendiums of the arts. The last-named service would be particularly desirable, as it would simplify a perplexing branch of the copy-sales activity and would become a double convenience to the public and the Office.

The extent to which the Scientific Library could be improved is limited only by the powers of the imagination. In connection with digests made by a permanent corps of examiners, it could, with a comparatively small additional expense, as appropriations go now-a-days, form a research laboratory for the development of facts on all published subjects pertaining or relating to the applied sciences. It should contain the best and completest fund of scientific information in the world, should have the necessary room and equipment for proper functioning and expansion, and should be provided with expert and adequate direction and assistance.

The Patent Office should also emulate other scientific bureaus of the government. It should get into intimate touch with the people, scientific establishments and the industries. It should have the services of experts in technical specialties at its beck and call and should have laboratories for testing disputed questions of utility of invention. It should issue publications from time to time explaining developments of arts as some of them become unusually active or vital, and should provide, by general and gratuitous distribution in pamphlet form and in popular language, information as to the patent system, the necessity of being capably advised before proceeding with an application, and an indication of the

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THE question has been asked very often of late years, "What is the matter with the Patent Office?" Almost as many different answers have been given as distinct answers. Certainly the Office is ridiculously undermanned and underpaid; certainly it finds it more than difficult to get Congress to pay serious attention to its plaints. Mr. Wyman, we think, puts his finger on the root of the trouble when he points out that where other departments spend and are expected to spend many millions against receipts that are practically negligible, the Patent Office is always looked to for a profit. The Government pays for every conceivable kind of research and investigation and propaganda; but patents, on which our whole industrial system is founded, pay for themselves and pay a profit. We have not space here to discuss this point more fully; we return to it on our editorial page.—THE EDITOR.

Recent Patents on Mixed Fuels

AN investigation into the subject of recent patents granted for inventions relating to mixed fuels for internal combustion engines for automobiles and so forth has been made by a Dr. W. R. Ormandy and published as an article in the official organ of the Institution of Petroleum Technologists. The author thinks that an alarming situation has arisen owing to the number of patents now existing, in which there is no real novelty, sometimes even no useful feature, in the invention claimed or in which the "invention" resides in a combination of materials having such well-known properties as to render its feasibility at once obvious to any person having some knowledge of these matters.

The paper refers to the enormous increase in the numbers of installations having internal-combustion engines requiring liquid fuel. A parallel to the present fuel situation is provided by the case of rubber, until the production of plantation rubber was seriously undertaken, and by the existing shortage of the long staple cotton required by the tire industry.

The increasing prices of the liquid fuels required by the motor industry led the author to examine the patent specifications, bearing on this subject, from 1913 onward, to see what evidence there was of an awakened interest in volatile fuels. The specifications bear evidence of the universal assumption that alcohol in some form will be a constituent of the motor fuel of the future. A number of specifications are described in detail. The inventions chiefly consist in the admixture of crude or other alcohol with the well-known volatile hydrocarbons of the paraffin series, known under the generic term "petrol." From one specification it may be gathered that in 1870 it was common knowledge that commercial alcohol containing 5 to 10 per cent of water could be caused to mix with paraffins and similar hydrocarbons in the presence of fusel oil or higher alcohols. Sometimes a "mixing or combining agent," such as fusel oil or amyl alcohol, is added to avoid non-miscibility due to the water present in the commercial alcohol.

A second group of patents has reference to methods of increasing the vapor-tension of alcohol, which is low, especially in cold weather, by the addition of ether, alone or in combination with alcohol and other substances. A third group comprises the addition or admixture of gases, such as hydrogen, the lighter hydrocarbons of the paraffin series or acetylene, to the hydrocarbons of low volatility, so as to lower their ignition temperatures. Sometimes ether, alcohol, or acetone is added to increase the solubility of the acetylene. One specification claims the use of alcohol saturated with acetylene; another the same mixture with the addition of 1 per cent of acrolein as a denaturant.

Thus it appears that patents have been granted for admixtures of bodies, which every chemist knows will mix, and every engineer knows will drive an internal-combustion engine. Such mixtures are, moreover, of obvious application, provided that the ingredients are obtainable at a reasonable price. Many patents have been granted, and, no doubt, many more will be granted for inventions which are matters of common knowledge, presumably because the patent records of the previous fifty years cannot show that anything of the sort has been previously patented. Such patents would not be granted in Germany. Under the amended Patent Act in this country, it is possible to oppose the grant of patents on the ground of the prior publication of the invention in a technical paper, document or foreign specification. The indiscriminate granting of patents for every conceivable mixture of inflammable organic liquids, which might possibly be used as a motor fuel, constitutes a distinct danger to the motor user, motor manufacturer and community alike.

The Influence of Cadmium on the Properties of Brass

CADMIUM possesses an influence upon properties of zinc and its alloys which may become injurious in certain amounts. A French investigator, M. Leon Guillet, has undertaken to determine the exact quality of this influence with respect to alloys of copper and zinc, and has published his conclusions in *La Revue de Métallurgie* (Paris).

Test pieces were taken from two series of alloys, one containing 70 per cent of copper and the other 60 per cent, the content of cadmium varying from 0 to 4 per cent. These were subjected to mechanical tests, traction, shock, hardness, etc. The following conclusions were arrived at: one per cent of cadmium in brass containing from 60 to 70 per cent of copper does not alter the mechanical properties. Since this percentage is never attained in these alloys constructors need have no fear of them. Examination under the microscope shows that these alloys have the normal structure of brasses and contain no free cadmium. When cadmium is present in more than one per cent the microscope reveals an increasing quantity of free cadmium. The cadmium is separated into filaments which have a tendency to surround the grains of the metal, and when the content becomes very high it forms spherical agglomerations recalling those made by lead in brasses. When this free cadmium appears there is a perceptible diminution in the chemical properties of the alloys.

The influence of the cadmium affects chiefly the resilience which undergoes an abrupt fall, whereas the other properties, especially those concerned in the traction test retain their high value. With a higher content of cadmium the elongations are lessened and soon reach a very low value.

Filtering by Means of Spun Glass

IN the Gulf Coast oil fields much trouble is experienced with the working barrels being cut to pieces by sharp and exceedingly fine sand, to say nothing of the annoyances caused by the tubing becoming filled to such an extent as entirely to block the rods.

Experiments have demonstrated the value of spun glass as a filtering medium. A strainer was made of pipe of two different sizes, the space between having been loosely packed with glass, and brown settlings and sludges from a Bayonne oil plant used as a test. The finest particles of foreign matter were filtered out, the process also increasing the most minute water globules to the size of a pea, making dehydration much more readily accomplished.

Glass is non-corrosive, its hardness approaches that of sand, and even the finest threads are of sufficient strength to span half-inch openings in a strainer. It can be easily cleaned with gasoline. During the experiments with this strainer, which showed the tendency of the glass to enlarge water globules, another apparatus was tried. A two-inch glass tube was filled with one-eighth-inch glass rods running longitudinally, and the brown settlings were pumped through from end to end. Microscopic water globules were found to increase in size to "slugs" of a teaspoonful, due to the difference in viscosity of the two liquids. It remains only to initiate experiments under working-scale conditions to demonstrate the commercial application of the invention.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Rule of the Road

To the Editor of the SCIENTIFIC AMERICAN:

I was interested in your note in the issue of the SCIENTIFIC AMERICAN of October 23rd, dealing with the change of road rule lately adopted by British Columbia. It was obviously inconvenient and unconducive to four horses were harnessed without a postillion to the left when elsewhere in the Dominion and in the United States the opposite is the practice.

At the same time the balance of argument, I venture to think, is in favor of the English method. The latter originated no doubt in the old coaching days when four horses were harnessed without a postillion to the vehicle. Much deftness on the part of the coachman was required to manipulate the long lash of the four-in-hand whip. It never was easy to give a touch to one of the leaders when it required it, but to do so from the left of the box seat would have been an action not only of extreme difficulty to the coachman but of considerable discomfort to his neighbors. The driver would naturally therefore adopt that rule of the road which permitted him at once to keep his right arm free and to judge best his distance from the wheels of oncoming traffic. This point obtains in a lesser degree today in the case of signals given with the whip to following traffic by the driver of, say, a two-horse van.

Again, it is the universal practice for a man when leading on foot a horse to do so with the right hand. Where the rule of the road is to keep to the right it is obviously dangerous to him. In this case he has to walk nearer to the middle of the road than his animal which, if restive, would very likely tend to push him still farther into the way of fast-traveling traffic. The contrary is the result under the English custom.

As to motor cars, it is, I believe, the general impression that it is easier to deflect to the left than to the right. If this is so safety needs no further argument.

So far as I can see there is only one argument in favor of the "keep to the right" rule. I admit, however, that it has cogency. It is that foot passengers keep to the right on the sidewalk. Under the "keep to the left" rule of the road when they step off the path they do so with their backs to the stream of traffic, and the danger for them, therefore, is greater. The question is then, which of the two methods has the greater recommendation. It is pardonable perhaps that I should allow this to the English practice.

MAJOR C. WARD JACKSON.

House of Commons, London.

[*The suggestion that an automobile turns more easily to the left is a new one so far as we are concerned. It would seem to us that the turn is easier when the driver is on the same side with passing traffic, with the curb or edge of the road on the other side of the car, just as in straight driving. We should think that so far as the motor is concerned, preference for the right-hand or the left-hand rule of the road is entirely a matter of right-hand or left-hand drive. Certainly our rule of the road is the reason for the left-hand drive in such a preponderance of American cars. This makes the matter adjustable, so far as the motorist is concerned.*—THE EDITOR.]

Specimens for Exchange

To the Editor of the SCIENTIFIC AMERICAN:

We are members of the Natural History Society of our school and we should like to begin an exchange of specimens with some of your American readers. Several other members of this society would probably also like to exchange specimens from their various geological, entomological, ornothological or botanical collections.

If any of your readers who wish to exchange specimens will write to us at the below-mentioned address we will do our best for them.

Ackworth School, Ackworth, No. Pontefract Yorks, England.

W. R. SANDY,
W. S. LEAN.

Motor Trucks and Country Bridges

To the Editor of the SCIENTIFIC AMERICAN:

In regard to your editorial under the above title: We have been getting excellent results on country bridges by changing our flooring from right angles to transportation, to parallel, and find it cuts down impact and vibration to a considerable degree.

It is also more economical as to replacements, as only the tread planks need renewal.

Lenora, Kan. J. C. BECKER.

Edison and Life

To the Editor of the SCIENTIFIC AMERICAN:

I have read in your number of October 30th the interview with Mr. Edison concerning his theory of the nature of life. It seems to me extraordinary that this great inventor and practical scientist could have indulged in such a futile and inconclusive process of reasoning. The problem is to account for conscious subjectivity (or personality) in man and to discover whether this conscious subjectivity persists or disappears. Mr. Edison's theory is that personality is merely the resultant of the joint action of myriads of hypothetical entities living in a community which disbands at the death of the organism they inhabit. These entities he endows (anthropomorphically) with human intelligence. Speaking of the restoration of the skin upon a burned thumb he says, "I firmly believe that the life entities rebuild that thumb with consummate care, drawing upon their remarkable memory for all details." In other words, he substitutes for the mystery of conscious subjectivity in man the equally insoluble mystery of conscious subjectivity in a theoretical being of infinitesimal dimensions. If Herbert Spencer were alive he would characterize this reasoning as "merely placing the problem a step further back."

The enigma of mind remains equally beyond the reach of our knowledge whether we think of it as appearing in man or in the far-fetched entities, which Mr. Edison supposes man to be composed of. Furthermore, it is of interest to inquire why, if the faculties of mind, as we know them in ourselves, are the ephemeral result of the community action of entities, these same faculties, as exhibited by the entities in the intelligent rebuilding of injured thumbs, should be immortal. Why are not the entities themselves mere communities of still more infinitesimal entities?

This incursion of our world-famous inventor into the philosophical field does not seem to have been felicitous.

New York. H. G. S. NOBLE.

XUM

Left: A snow-survey observatory on Mount Rose, 10,800 feet up. *Center:* Snow-survey station at Lake Tahoe, showing hood to protect instruments from current snowfall. *Right:* Snow surveyor removing his snow-filled sampler from the snow

Measuring a year's crop of snow in the California and Nevada mountains

Surveying America's Snows

How California and Nevada Forecast the Amount of Power and Water That They May Expect Each Year

By James Anderson

ONCE more the eyes of the world, or at least every section of the globe where heavy snowfalls are of periodical occurrence, are focused on the United States. For this country has taken one more step forward in the world of science. Realizing that probably the greatest stock of potential energy, greater perhaps than that of water, the snow in the mountains, was unmeasured and its moods not fully understood, the State of California has joined hands with Nevada and the United States Weather Bureau in a survey of the snow in the Sierra Nevada Mountains in an effort to forecast the stream flow in the two States. The progress of the movement will no doubt be a vital factor in the industrial and agricultural pursuits of those sections of the world where heavy winter snowfalls are of annual occurrence.

When these surveys have become general and results have been carefully tabulated and regularly published it will be possible for farmers to determine accurately in the early spring the exact amount of water they can depend upon during the summer months or growing season for irrigation purposes and they can thus plant their crops accordingly. Manufacturers depending upon water power to run their plants will also be able to figure how they will come out in this respect even during the dryest seasons.

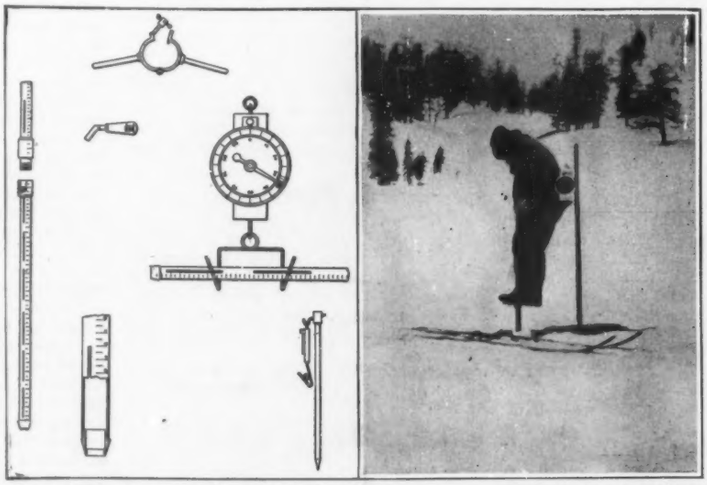
Although pastiming in the white mantle of nature is considered primarily a winter sport, the business of snow surveying is indulged in during the spring and early summer months. A comprehensive plan has been developed to study the mountains of California and Nevada as one great system. Two quadrangles have already been formed consisting of the Central Sierra and Northern Nevada watersheds. Two more will soon be formed, consisting of the Southern Sierra and Northern Sierra Quadrangles. How large these quadrangles are can be estimated from the fact that the Central Sierra Quadrangle includes the Yuba, American, Mokelumne, Stanislaus, and Tuolumne Basins on the west slope with the Tahoe, Carson, and Walker Basins on the east.

Eastern and western outposts to the crest stations will be established in every basin to determine oscillation in the snow cover. The monthly increase of the snow cover and the probable demands will be determined by surveys at key stations each mouth throughout the winter, while a comprehensive survey will be made in April and May to determine the summer flow.

The origin of this new industry is peculiarly interesting. During the winter months both the faculty and student body of the University of Nevada for years derived a great deal of pleasure and sport from trips to the highest snow-clad peaks of the surrounding mountains. Dr. J. E. Church, Jr., was regarded as one of the leaders in these pleasure excursions. After innumerable trips into the winter Sierra his feeling changed from one of pleasure hunting to business. He remained longer than usual and started to investigate the snowfalls from a practical point of view.

That was about ten years ago. He became so interested in his observations that on the summit of Mount Rose, which overlooks Lake Tahoe, and rises to a height of 10,800 feet above sea level, he established a mountain observatory and, in comradeship with a constantly changing series of faculty and student enthusiasts as the years passed by, gradually developed the method of snow surveying. This, in its simplest form, consists in determining the seasonal percentage of the winter snow cover of the high mountains and using the percentage thus gained as closely representative of the summer flow of the streams which are fed from this source of snow supply.

"Ten years have been spent at Mount Rose Observatory in developing our work," said Dr. Church in telling of this new science of snow surveying, "and many years more will be necessary under the coöperative plan to bring it to fullest service of the farmer and the manufacturer. The ultimate goal is to develop a despatchership of streams similar to the despatchership of trains on the great railway systems.



Left: Diagram of sampler and the dial that enables the surveyor to estimate the water equivalent of the snow it brings up. *Right:* Driving the sampler into a deep snow deposit

Finding how much water will run out of a big basin from the snow that lies therein

"After my years of observation I have found these surveys to be unfailing in their determinations of stream flow, allowing for a maximum of a twenty-five per cent shrinkage at times, which may be accounted for by lack of precipitation in April and May. Rain or snow falling in these months is conserved to a better advantage than that falling in June or July, for the obvious reason that during the latter months the moisture soaks into the soil of the mountains, and does not run off into the mountain streams. Shrinkage is one of the most vital problems related to stream forecasting.

"That there is a general relationship between the snow cover and the flow of the streams has long been known and attempts to correlate the two have long been made. Earliest, because of its simplicity, was the method of accumulated snow fall by which the depth of the snow was measured storm by storm. But the density of the newly fallen snow varied so greatly that even the average of a large number of snow falls occasionally caused seasonal distortions as high as thirty-five per cent between the estimate and the run-off."

Dr. Church then explained that the "percentage method" merely involves the searching out of representative areas in the high mountains where the snow lies level and unmelted from autumn to spring. Because of this fact late spring or early June is considered the best time of the year to do the work of surveying. Courses sufficiently long are laid out to assure an accurate average of the water content of the snow. The average of the annual measurements over a period of years is the standard from which are computed the seasonal percentages. The normal flow of the stream draining the basin is determined in a like manner from the stream measurements made by the U. S. Geological survey.

The instrument used in the surveys is a thin, steel tube so small in diameter that it can be extended by additional sections to a length of 20 feet without becoming too heavy to drive. A milled cutter and special adjustable wrench on which the surveyor can stand and thus become a human pile driver makes it possible to drive through snow however hard and deep. This sampler is now being used by the Swiss Glacier Commission to penetrate the upper layers of the Alpine glaciers and unlock the secrets of glacial growth. An aluminum spring balance with adjustable index, to eliminate the weight of the sampler, makes possible the immediate determination of the water content of the snow without computation.

The chief disturbing factor between the equilibrium of the estimates and the

(*Continued on page 603*)

A Unit System of Freight Transportation

By Charles N. Winter

THE economic efficiency of the United States and of the world at large is being seriously hampered by the inadequacy of the transportation systems upon which the world's commerce depends. This is particularly true of the railroads of the United States but applies to the waterways as well. In both these branches of transportation, the terminal facilities are unequal to the constantly growing demands made upon them. The methods now employed to handle freight are for the most part so antiquated and slow that it is practically impossible to handle the business offered to them. A step toward relieving the situation appears to have been made by the use of the freight unit shown in the accompanying illustrations.

This unit consists of a rectangular container made of steel plate strongly reinforced with angle-irons and designed to be interchangeable between a truck, a railroad flat car, or a boat, thus linking the manufacturing plant with either rail or water transport, by means of the motor truck. It speeds up the handling of freight by loading it into a 2½-ton or a 10-ton container and moving the container with the contents undisturbed instead of handling a large number of smaller packages. This not only facilitates the transfer of merchandise, but as the container is both weather-proof and thief-proof, the loss so frequently incurred from those causes is eliminated. In addition, the manner in which the freight is packed in the container and the fact that the freight itself is handled only at the shipping point and at its destination, will prevent much of the damage occurring in train movement when goods are loaded loosely in a car or when less than carload shipments are transferred at junction points.

The complete equipment includes a specially constructed flat car which, however, differs from those now in use on the railroads of the United States only in providing a means of clamping the containers fast to the platform of the car. Engineering estimates place the cost of equipping a car with five 10-ton units at $1,000. The flat car may be constructed for the same cost as those in general use or an ordinary flat car may be altered to carry the containers at an approximate cost of $250.

This system was adopted by the United States Railroad Administration after an extended investigation of freight handling methods both in the United States and abroad. It was placed in operation and used successfully in inter-water-rail transport on the Warrior River in the New Orleans district for handling war supplies.

The containers used in that service are of 10-ton capacity and have side doors through which package freight is loaded or unloaded. Steel cables attached to lugs at the top corners of the container provide a means of lifting it from a truck and placing it on car or boat. To do this a crane or derrick or similar equipment is required. Such devices usually are available at manufacturing plants and in the larger freight yards and terminals but when, at small freight stations, such apparatus is not available the containers may be placed on a car and loaded in the sme way as an ordinary box car.

Another type of container is used for handling loose bulk material such as is generally carried in a gondola car. This type is constructed with top doors—and sometimes with a drop bottom—and can be loaded by hand or with material handling devices such as automatic buckets. This container is lifted by links attached to a spreader bar and engaging in slotted trunnions on the sides of the container. When the loaded container is in the desired position, the link latch is withdrawn and the container overturned, discharging the load or, when of the drop bottom design, the load is discharged through the bottom.

Other designs of this unit provide for refrigerator service; for the shipment of live stock; and tanks for liquid shipments. This system therefore is extremely flexible and any or all of the various classes of freight may be transported in small quantities on the same car with many of the advantages of carload shipments and none of the disadvantages of the present method of shipping less-than-carload freight.

Conservative estimates based on the performance of the new freight unit in government service indicate that the handling of freight may be greatly expedited by its use and that the cost of handling will be reduced to one-third or one-fourth of the cost of the older methods of handling the individual packages.

The advantages of this system are that it will unify the highways, the waterways and the railways; deliver freight from origin to destination without rehandling regardless of distance or number of transfers; protect freight from theft, contamination, or fire and water; increase the transportation mileage of motor truck equipment; permit the loading of freight before the arrival of the car; unload and release cars in from 1 to 2 hours instead of 12 to 24 hours, thus increasing freight car mileage; and convert a flat car into a box car or a gondola car as may be desired. Because of the great decrease in the time required for loading or unloading it will increase the capacity of terminals without any outlay except for the lifting apparatus. Its use should reduce joint river-and-rail rates, speed up river traffic, and relieve congestion at terminals.

The St. Paul bridge that runs like an elevator and is operated like a street car

Applying Elevator Principles to the Railroad Bridge

By Hjalmer Lindquist

INSTEAD of swinging on a pivot or opening like a jackknife, a Minneapolis railroad bridge lifts itself up after the fashion of an elevator. The mobile section between the two towers is 96 feet long; its weight is 450 tons. This great mass is counterbalanced by two huge concrete weights, one at each end of the elevating section, together weighing nearly as much as the bridge section itself, so that two electric motors in the house on top can lift it with ease to the height of 55 feet in order to pass river traffic.

The concrete weights that slide up and down in the towers are each connected to the end of the movable section by 16 two-inch cables, eight on each side of the weights, passing over the large pulleys at the top of the steel towers. The signal control and lifting machinery is in the house on top of the bridge.

When a boat signals its desire to go under the bridge, the watchman turns on the electric current that operates the signal system and manipulates two levers controlling semaphores at either end of the bridge in order to warn all trains to stop. He must then wait a full minute before he can unlock the bridge section from its two ends. This is accomplished by pushing a lever. Switches are simultaneously operated as to derail any train attempting to pass the danger signals.

With the trains blocked at both ends of the bridge, the operator now unlocks the section, steps to the control drum, and gradually applies the current which operates the lifting motors. This control drum has much in common with the street car controller; in fact, the entire operation of lifting the bridge follows the manner of running an electric car. To raise the bridge the current is turned on and increased gradually. Going down, the reverse lever is first pushed into position and the power is gradually applied.

Signal lights on both sides of the bridge at night indicate to boat pilots when it is safe to pass under the raised bridge. A ball signal on top of the station, which may be raised and lowered, is used in daytime.

On the wall and rising from the floor of the control house are indicators that give the operator all the information he needs, making it unnecessary for him to look out the windows. Indicators tell the bridge operator if there are trains standing on the approaches and on what tracks they happen to be. A machine rising from the floor tells him to the fraction of an inch just how high his section is from its bottom or resting position. The operator cannot see at night how things are on the outside and no chances are taken of his making a mistake through the day.

A worm screw, about two feet long, is timed to trip a lever and break the circuit at both ends when the bridge section has come within three feet of the top or bottom of its travel. This device also makes for safety by stopping this machinery; it warns the operator to look at his indicator. To start it again he has only to press a button on the drum.

The average time to bring the bridge to the top of its 55-foot way is one minute; it can be done in half that time. The downward speed is the same.

Left: Ten-ton freight unit containers, locked on an ordinary flat car, being loaded at a small freight station where no handling equipment is available. *Right:* The method of handling the units at a large station

Bulk and small-package freight in handy standard containers that stay with their contents to the ultimate destination

XUM

Wanted: An Inexpensive House

A Review of the Building Situation and a Few Timely Suggestions

By Harry A. Mount

THE present housing situation, viewed through a pair of horn-rimmed spectacles over a mahogany committee table, presents an unusually knotty problem. But viewed through the eyes of the man who, with his household goods in storage and his family in a hotel, watches his savings account melt away while he searches frantically for a "permanent location," the whole matter is taken out of the category of problems and heads the list of pressing necessities.

Many thousands of persons have viewed the housing problem from this angle in the past three years. Those who have not solved it in a makeshift way have sooner or later come to consider how they might own their homes, with a limited cash outlay.

Everywhere in the building industry just now one is impressed with the fact that this a poor time to build a home. The cost of materials and labor is such that experienced builders have almost ceased operations. Such building as is going on is under the press of necessity or is being done by realty speculators who hope to dispose of their houses at a large profit before the housing shortage can be relieved.

Now as a result of this cessation of building there is already noticeable a considerable downward trend in the price of building materials. Men who have studied the situation emphasize the fact that thousands of persons who have bought homes of their own on the partial payment plan have taken upon themselves a bigger financial burden than they will be able to carry on a falling market. One large manufacturer of ready-cut houses made the frank prediction to the writer that within two years hundreds of these houses built for speculation would be upon the market at very reasonable prices.

A man need not go deeply into present building conditions to discover that it it is neither possible nor desirable to engage in ordinary building operations at this time on a moderate income. But as to the desirability of building now, the foregoing fact can be overlooked when building is a necessity. Then, too, there are ways to economize in building a small residence to bring the cost within average means, and that is the subject of the following lines.

First of all, let us admit that if the home-builder has a little mechanical ability and is able to wield a hammer and saw, the problem is much simpler. Now then, we must begin by acquiring a bit of land—a lot, if you please.

Once the lot is clear of indebtedness a building loan can usually be negotiated. Building and loan associations are organized for this purpose. Some of them, however loan only to bonafide home builders and refuse loans to realty speculators. Such firms are likely to treat the builder with far greater consideration than might be had elsewhere. One New York concern employs investigators who, when payments on a loan begin to fall in arrears, discover whether or not there is a real reason, and whenever possible arrangements are made to tide the borrower over a temporary financial stringency. Thousands of other firms are just as considerate in making loans to home-builders.

One of the first considerations in laying plans for a small home should be the local building restrictions. When possible a copy of the local building code should be secured and carefully studied. If much of the work is to be done by the builder himself a preliminary study of the code may save him costly rebuilding and a possible fine later, should a building inspector suddenly appear on the scene.

It is far safer, when one intends to do part of the work, to secure the advice and assistance of an experienced carpenter from the very beginning. The whole job will proceed faster and at less expense under his direction.

Another precaution to be observed is this: do not buy your lumber and materials at the nearest lumberyard without asking prices elsewhere. At times there is a sharp difference in prices even at nearby lumberyards, especially under present abnormal conditions.

Under very favorable conditions, and provided a part of the labor is done by the builder, a three or four-room cottage can be built for as little as $1,500. This figure contemplates a very small house of rather severe architecture, but well built and sealed so that it would be suitable for winter use. Let us have no illusion regarding a $1,500 house.

It would have no cellar; it would be roofed with composition shingles, and plaster board or wall board would be used on the walls. On each of these items there is a great saving in labor over standard practise.

If one has sufficient spare time, or can spend the days of one's vacation solving the housing problem for once and all, even the services of the carpenter can safely be dispensed with if one of the various types of fabricated houses now on the market is purchased. The lumber for these houses is delivered from the factory ready cut. Complete instructions accompany the materials and any man who can drive a nail straight can put them together. In some types the lumber comes made up into sections and these have simply to be nailed or bolted together.

The manufacturer of ready-cut houses has already taken care of the details such as design, compliance with building codes, selection of proper materials, etc. Because these houses are produced in quantity in a well equipped factory, the labor cost on the work already done when the lumber is delivered is obviously considerably less than if it were done on the job. The services of the architect who has designed such a house would be beyond the reach of the average home-builder; and the assurance that the architecture is correct is most comforting, even though the house be a modest one.

Buildings of the ready-cut type range from lightly-built summer houses of three or four rooms to eight- or nine-room houses, running in price from a few hundred dollars to $15,000 or more. The home shown in the accompanying photograph is the most popular model of a highly popular line of fabricated houses. It contains five rooms, ideally arranged for the small family. The cost, complete with foundation, plumbing and lighting equipment, ready for occupancy, is about $6,000. The cost of the bare house is $4,500 at the factory.

In this type of house, the material is made up into three-foot sections at the factory and the whole house is put together without nails—excepting in the walls—bolts being used throughout. Even the shingles are put on at the factory; it is only necessary to slip under a few lap shingles after the sections are in place, to complete the exterior. The idea must not be gained, however, that the construction is flimsy. On the other hand the finished house is of extraordinarily sturdy construction and will pass the most rigid building inspection. The walls inside are finished with plaster board and the house is said to be very cozy for winter use. The factory equipment for the house includes such details as hardware and bricks for the fireplace and flue.

Although the house has five spacious rooms, it occupies only 768 square feet of ground. From the front porch we step directly into the combination living and dining room, through double French casement doors. This room extends across the entire front of the house and a large fireplace in the center adds to its coziness.

In the rear of the ground floor are the kitchen, bath, a bedroom and the stairway to the upper floor. Above we find two cheerful bedrooms. The upper rooms are so constructed that very little of the roof touches them, giving good insulation from outside temperatures. The waste space under the roof is utilized in providing an abundance of closet space.

There is little hope of escaping high costs by the use of material other than lumber. Stone, brick, or cement construction, even though materials may be plentiful and at hand, require expert labor and the final costs are usually much higher than those for lumber. Certain types of molded cement construction, however, compare favorably with wood in cost. One of the most successful of these utilizes a double wall construction, with a dead air space between so that the house is suitable for use in climates where extreme temperatures are encountered. The walls are built by the use of a single mold, about three feet long and a foot deep. This consists of four steel plates held parallel by steel braces at the top. The plates are adjustable so that thickness of the walls and air space can be varied at will.

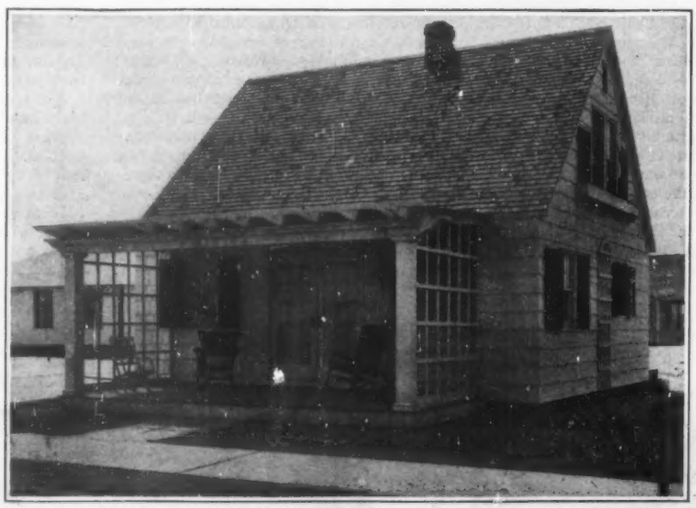
Concrete is mixed with only a small amount of water and is then tamped into the mold, directly on top of the foundation. Without waiting for the concrete to set, the mold is moved along the wall and another section tamped in. When a complete layer of the wall is thus built up, another tier is begun on top of it and the process continues round and round until the house is finished. The interior walls are of a single thickness of concrete and the whole construction is locked firmly together by the use of special tie-rods which are molded into the concrete.

The windows and doors in this kind of construction are set in place and the walls built around them. A stucco finish is usually applied to the outside and the plaster is applied direct to the inside walls. Cleats, to which the rafters are nailed, are built into the walls.

This concrete construction depends largely for success upon good workmanship, and the company which controls the patents sells the necessary apparatus

(*Continued on page 603*)

IT was altogether to be expected that the Editors of the SCIENTIFIC AMERICAN *should be appealed to for aid with regard to the housing shortage. Here and there large plant executives and municipal authorities have asked for guidance in the matter of building homes for workers whose means called for inexpensive houses. And these appeals were answered by mail—answered individually and personally so as to take care of the peculiar requirements of each. All of which prompted us to formulate an interesting little problem in building, namely: Can a house be built for $1,000, and how? Mr. Mount, one of our regular correspondents, has attempted to solve the problem in the accompanying account. He sets the lowest limit at $1,500 for a very modest house, and gives a number of suggestions for inexpensive building operations. But our problem remains unsolved! Can any of our readers solve the $1,000-house problem?*—THE EDITOR.

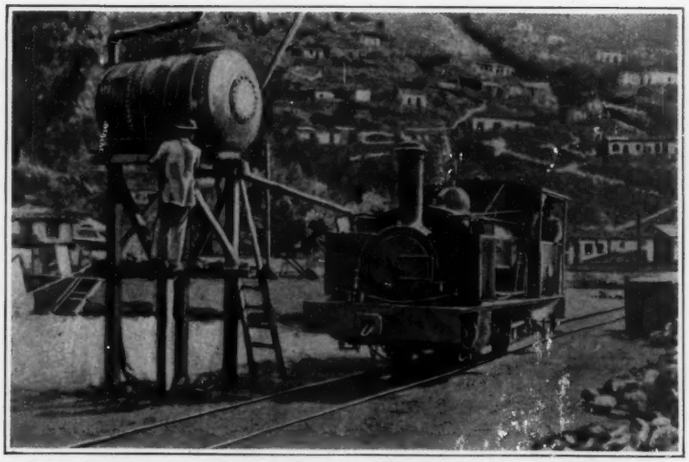


Here is a typical ready-cut house which is assembled by means of bolts in a minimum of time. The cost is about $6,000.

Venezuela's Mountain-Climbing Oil-Burning Locomotives

By Harry Chapin Plummer

OIL-BURNING locomotives have lately supplanted coal engines on two of the steepest of trans-mountain railways in the Republic of Venezuela. The Minister of Public Works, Dr. Luis Vélez, reporting upon the success of the experiments with oil-burners, discloses comparative figures covering the running cost of trains over the 22.36-mile line on a 3.75 per cent grade and proves a saving of not less than sixty per cent in cost per train mile in favor of the new principle. The railway upon which the official experiments were conducted is the British-owned road operating between La Guaira, the chief seaport of Venezuela, and Caracas, the capital city. Hitherto the line has been operated at an annual cost per train kilometer (0.62137 miles) of 6.31 Bolivars ($1.26).



Refilling the tank of a Venezuelan oil-burning locomotive employed over the mountain railroads

The latest economy to be effected in the management and operation of the Caracas-La Guaira Railway bids fair to further its reputation for earning capacity. Within a quarter of a century the ratio (representing net revenue) of operating expenses to income was widened from Bs 1,972,282.46 ($385,656.49.1), the disbursement total for 1893, as against a gross revenue for that year of Bs 3,641,565.89 ($728,313.19.4), to Bs 965,232 ($193,044.20), the disbursement total for 1918, as against a gross revenue for that year of Bs 1,782,375 ($356,475).

Yet another of several British railways in the country, which represent an aggregate investment of Bs 89,485.500 ($17,897,200), has adopted the oil-burner.

The total railroad mileage of Venezuela today is 1,039 kilometers (645.37 miles). Three of the roads are State-owned, two are privately operated by Venezuelan companies and seven are under the control of English, German and French interests.

Minister Vélez, in reporting to the Venezuelan Congress upon the Caracas-La Guaira Railway observed:

"An instance of progress which we consider very important from the practical and economic point of view, introduced recently in the operation of some of our railways, is the use of national crude petroleum as a combustible for the locomotion of the trains. This practice has for us actually a double value—that of the traffic in a national product and that of our market coming under the influence of the universal crisis growing out of the war in the branch of combustibles. Five companies have commenced to introduce this improvement or to equip their respective hauling apparatus for the change in fuel."

Citing a test made on the heavy grade of the ascent from La Guaira to Caracas in two trips over the 22.36-mile run, in one feeding the locomotive with Cardiff coal bricks and in the other with crude petroleum, the comparative results are set forth as follows:

	Trip in which Cardiff coal was used	Trip in which crude petroleum was used
Dead weight of train	50 tons	63 tons
Total consumption of combustible on each trip	850 kgs. coal	660 kgs. pet.
Consumption rate per ton and per kilometer	0.47 " "	0.29 " "

"In order to make clearer our comparison," the report states, "suppose the two trains had been of equal weight, of fifty tons each, in that case the combustibles expended would have been, proportionally:

In the case of the coal, 850 kilograms
In the case of the crude petroleum, 524 kilograms

and taking into account that the prices which these combustibles have cost the railway company have been, in the port of La Guaira:

1 ton of Cardiff coal briquets Bs 124 ($24.80)
1 ton of crude petroleum..... Bs 74 ($14.80)

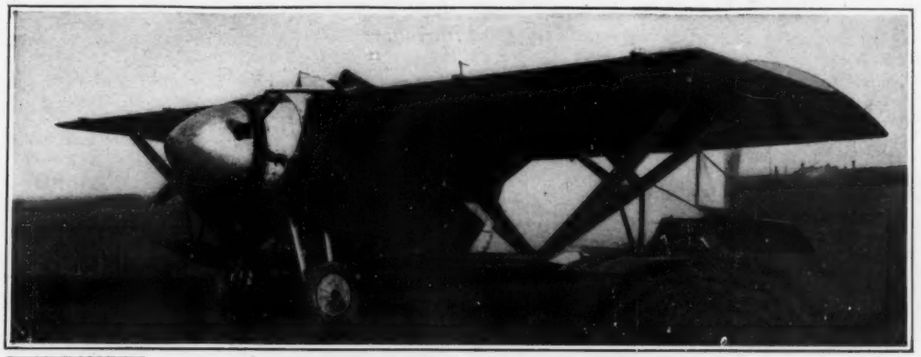
results in showing the cost of the necessary fuel in each trip to have been:

Employing Cardiff coal.. Bs 106.75 ($21.35)
Employing crude petroleum Bs 38.78 ($7.75.3)

that is to say, that the use of crude petroleum develops an economy of more than sixty per cent—a very material economy, to be sure.

"From this result it is not difficult to present the following figures, experimentally obtained, as to the comparative properties of the two combustibles used in very thorough trials:

(*Continued on page 603*)



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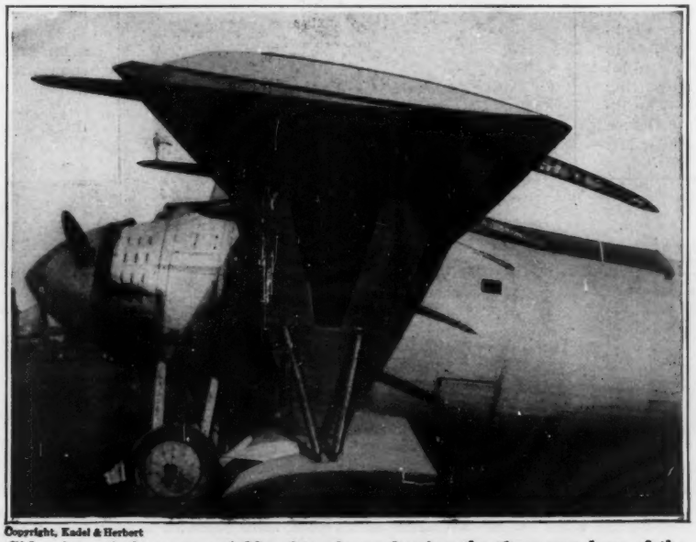
Three-quarter view of the new French airplane with the variable top wing for increasing the speed while in flight and slowing down for a landing



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Side view of the new variable-wing plane, showing the three members of the top wing almost entirely overlapped or closed

An Airplane with Variable Wing Surface Area

By Alfred Longville

THE idea of varying the area of the airplane wing while in flight is by no means new. As early as 1910 certain French designers conceived of airplane wings with airfoils that could be rolled up much after the fashion of the sails aboard a sail boat. The idea has always been to employ a wide expanse of wing surface while climbing to the proper altitude, and then reduce the wing surface in order to increase the horizontal speed. But the apparently successful execution of this idea is a matter of current event, and then only on an experimental scale.

No lesser aeronautical minds than Gastambide, Levavasseur, and Latham, the latter a cousin of the famous aviator of that name who was killed in Africa while on a hunting expedition, have evolved an airplane with wings of variable area. The new airplane, which is shown in two of the accompanying illustrations, is a one and one-half biplane, so to speak, for the reason that the lower wing is barely half as large as the top one. The machine is equipped with a 250-horse-power engine, driving a single tractor screw. The body is exceptionally thick yet properly streamlined to obtain the best aerodynamic results.

The novel feature of the airplane is the top wing, which, it will be noted by studying the accompanying illustrations, is the variable member. It consists of three sections, two of which, the top and the bottom one, slide more or less over and under the middle section which remains stationary. The narrowest width of the plane closed is 1 meter 60 centimeters (63 inches), while fully extended the plane is 3 meters 28 centimeters, (129 inches). The speed is given as 60 kilometers (37 miles) per hour, with full spread to 200 kilometers (124 miles) per hour, with the wing entirely closed, or a ratio of better than 1 to 3. The wing area is given as 52 square meters with wing fully extended, and 32 square meters with wing entirely closed.

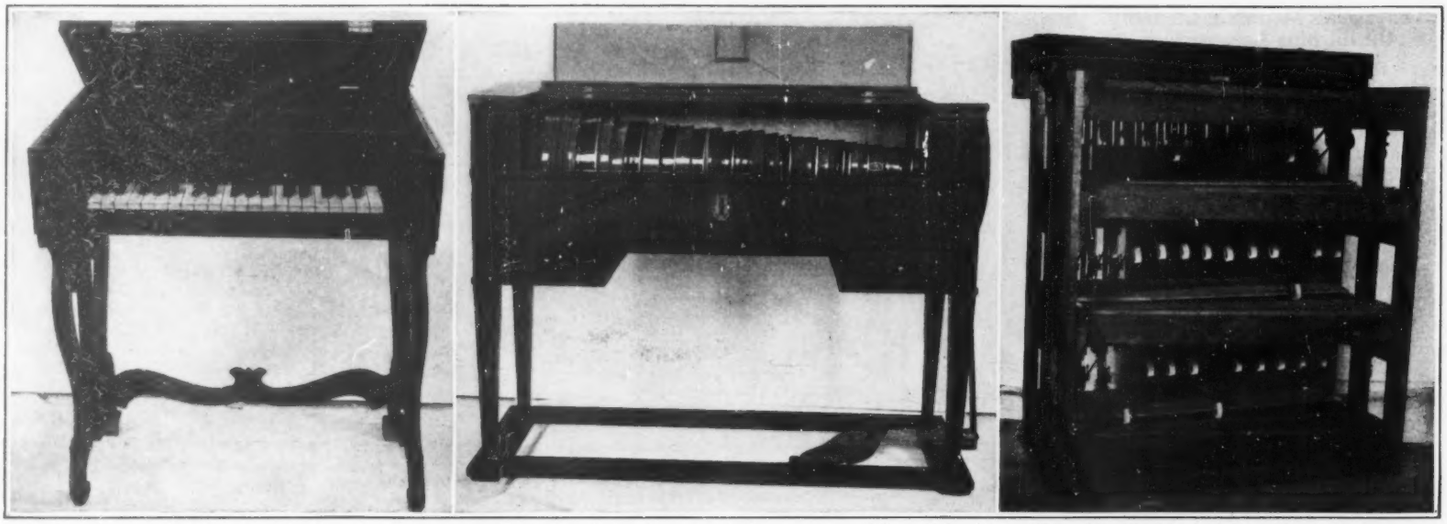
The aviator Grandjean recently piloted the new machine at the flying field at Etampes, France, with excellent results, proving the practicability of the variable wing feature. For military purposes the machine has an immediate and invaluable use, since it can be slowed down for observation and photographing purposes, and speeded up at other times. For sport and commercial purposes, too, this variable speed feature is of prime importance, since it makes for safer landings. All in all, the new airplane points the way to a new and safer era in aviation.

Paper from Veneer Waste

IN the wood waste from veneer factories the U. S. Forest Products Laboratory sees considerable raw material suitable for the manufacture of high grades of paper. The cores of many kinds of veneer logs, now used in a large part for fuel, would make excellent pulpwood. In addition, a large part of the clippings could be turned into pulp stock with profit.

Among the veneer woods whose waste has paper-making possibilities are red gum, yellow poplar, cottonwood, birch, tupelo, basswood, and beech. Many veneer factories cutting these species are already within shipping distance of pulp mills. In certain other cases veneer factories are so grouped that they might furnish pulpwood enough to warrant the erection of a centrally-located mill. Other economic factors being favorable, such a mill could profitably operate on a daily supply of veneer waste equivalent to 50 cords of ordinary pulpwood.

XUM



Left: Flat glass rods in the case are struck as the keys are depressed. *Center:* A glass harmonica built on the general lines of Franklin's. *Right:* The glassichord of the early nineteenth century, showing mode of operation

The glass harmonica and its near relatives are sometimes got up quite elaborately

Music from Glass

Franklin's "Harmonica" and Other Instruments of the Same Class

By J. F. Springer

THE idea of getting musical sounds from drinking glasses or glass basins is at least as old as the middle of the seventeenth century. The finger would be moistened and the hollow glass vessels set into vibration by applying the finger thus prepared. Thus, in an old book printed at Nuremberg, directions were given how pleasing musical tones could be produced. Eight glasses of similar shape, and presumably equal size as well, are taken. Then, a spoonful of wine is put into the first, two spoonfuls into the second, and so on. Eight persons, each with wine-moistened fingers, are now to pass them over the several brims. It is said that there will be heard "a very merry wine-music, that the very ears will tingle." We have here what is apparently an inexact description of how to prepare a complete scale together with the octave of the key-note. Those who try it will doubtless find that the proper intervals from note to note are not so easily got as the description seems to indicate. Naturally, the wine will be no better than water in the various vessels. It was also suggested, in the same account, that a lesser number of glasses might be used and the arrangement be made "by order of intervals of thirds, fifths, and octaves, and, according to the size of the glasses, augment or diminish the wine."

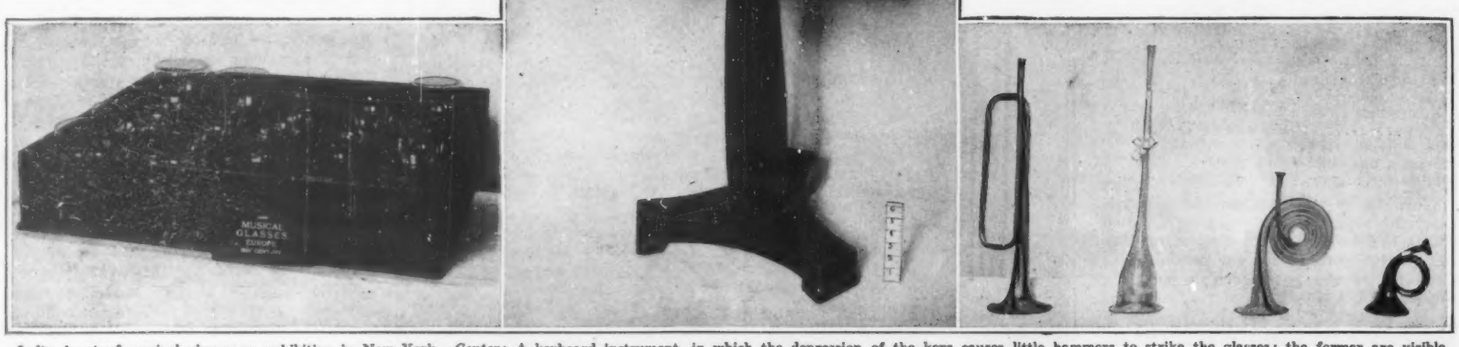
However, from this beginning, the famous *glass harmonica* may have been evolved, although Benjamin Franklin is nevertheless to be credited with its invention. But he himself attributes the first thought of playing tunes upon drinking glasses to a Mr. Puckeridge, a gentleman from Ireland. According to Franklin, Puckeridge actually grouped together a lot of glasses of different sizes and tuned them by putting in more or less water, as the case demanded. The instrument together with its maker and the house itself was unfortunately destroyed by fire. But a Mr. E. Delaval, a member of the Royal Society, imitated and apparently improved upon the earlier instrument. He gave particular attention to the form of the glass. This was the first instrument seen or heard by Franklin. He was delighted with the sweetness of the musical tones.

In Franklin's instrument, the seven notes corresponding to the natural scale were painted red, orange, yellow, green, blue, indigo, purple, and then the same succession of colors was given to the next octave. By this device, octaves were always of the same color. The five glasses representing the interspersed intermediate tones, which we usually assign on the piano to the black keys, he colored white. The player seated himself before the middle of the set, just as he would in seating himself at a piano or organ, and turned the glasses by a mechanical device operated by the foot. Every now and then they were to be freshly wetted with a sponge and clean water. "The fingers should be first a little soaked in water, and quite free from greasiness; a little fine chalk upon them is sometimes useful to make them catch the glass and bring out the tone more readily." Both hands could be employed, so that some attempt at harmony was possible. "Observe that the tones are best drawn out when the glasses turn *from* the end of the finger, not when they turn *to* them." Franklin's improved form of instrument dates from about 1762. There is, in the *Vicar of Wakefield*, an apparent reference to the novel instrument under the name of "musical glasses."

The instrument was used in exhibitions in France, Germany and Austria. The noted Italian poet, Metastasio, heard the instrument in Vienna and became enthusiastic. A certain Ferdinand Pohl, an artisan living in a Bohemian town, heard of the famous instrument, but appears to have had few details. He knew, however, that glass was the fundamental material. With this in mind, he thought that the glass bells used to protect clocks from dust could be utilized as means for producing the notes. His first instrument was at last finished, after much effort and neglect of ordinary duties, and he opened the door of his work-room to call his wife. Just then, a draft slammed the door with the result that a picture fell and ruined the instrument. Nevertheless, he went to work again, and this time with more lasting success. The Pohl form of instrument became celebrated throughout the world.

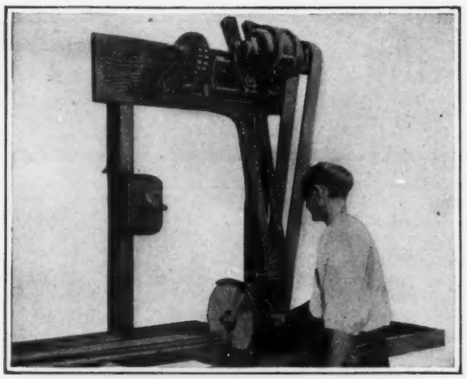
The glass harmonica has not become a permanent thing. There are probably a number of instruments—

(Continued on page 604)



Left: A set of musical glasses on exhibition in New York. *Center:* A keyboard instrument, in which the depression of the keys causes little hammers to strike the glasses; the former are visible but not the latter. *Right:* Nineteenth century glass horns producing a single note each

Some unusual musical instruments of glass



This swinging saw is so constructed that it cannot swing back and injure the operator

Swinging the Saw to Cut the Wood

A CINCINNATI manufacturer has lately brought out a new type of swing saw which protects the operator by its new mechanism swinging the saw back automatically and away from the lumber being cut when the handle is released. This allows the operator to remove the cut lumber without the danger of the saw swinging back and cutting his arm or hands. The safety lock attachment keeps the arm from swinging forward unless the handle is pulled by the operator.

The saw is a self-contained unit and may be easily installed by hanging to any convenient wall or column and connecting motor to the nearest electric wires. A switch inserted on the saw frame makes it possible to turn off the current when the saw is not in use without leaving the work in hand.

The safety feature of the saw will make it particularly adaptable to the use of merchandising plant shipping departments where frequent changes of employees might result in serious accidents with the use of machines not equipped with the safety device.

Paper Pulp in New Zealand

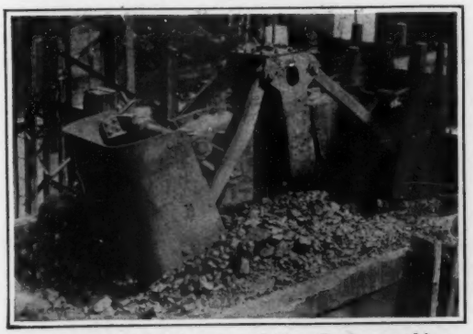
THE New Zealand Government has granted a lease of 30,000 acres of white pine land and also water rights for the generation of electric power to a company which intends to use the pine for paper-making, a purpose for which it is claimed as very suitable. At present all the newspaper used in Australasia comes from either Canada or Scandinavia and the pine has risen from under £20 to £80 a ton in the last few years.

Enclosed Gears for the Clam-Shell Bucket

THE use of clam-shell buckets in handling bulky materials, such as coal, sand, gravel and cinders, has always been accompanied by expense and serious delays made necessary by the renewal of operating cables and chains. Ordinary clam-shell buckets are so constructed that a large quantity of the material handled comes into contact with the operating parts of the bucket. This results in excessive wear of the operating parts due to the abrasive action of the material.

Such faults have been eliminated by the clam-shell bucket developed recently by a Cleveland manufacturer. All of the working parts of this bucket are enclosed in a tight casing where they are constantly lubricated and where they do not come into contact with the material being handled by the bucket.

The bucket is made of a minimum number of parts which are arranged to facilitate the removal of any part in case of necessary repairs. The accompanying close-up view shows the bucket's simplicity.

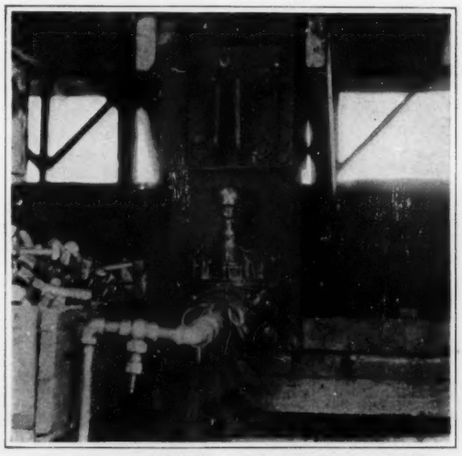


A clam-shell bucket in which all the working parts are enclosed and protected

Using Compressed Air to Reclaim Bolts

A BOLT-RECLAIMING device is the invention of H. U. Prindle of a Pacific coast shipbuilding company. It is destined to hasten the work of preparing bolts that have been once used, for further use. Customarily, this work is done by hand, it being necessary to work the nut off the bolt—generally this necessitates a hammer—and then to clean the threads. Frequently it is necessary to re-thread a bolt, or to make a smaller bolt from it, in order to use it all. The average number of bolts cleaned per day by hand, as against the number with a machine, varies in the proportion 198 to 1,000, over five times the number being accomplished with the machine.

This machine was built of scrap iron and steel. It consists of a receptacle for the nut—the round object in the center of the picture—which revolves in either direction, and a stationary slot for the bolt, to insure its being held straight. This is the slot seen just above the nut-receptacle. To reclaim a bolt, it is slipped in the machine and held by hand, while the receptacle for the nut is worked back and forth rapidly, a short distance at a time. This not only removes the nut, but also cleans the threads without injuring them and increases the efficiency of the nut from three times, as is the case with the hand method, to ten times or more with the machine. Four other similar machines are being built at this shipbuilding plant.



An air-operated bolt reclaiming device which expedites the cleaning of screw threads

Iron and Steel in Australia

THE Australia output of iron and steel, at present comparatively small, will probably show a marked increase in the near future. The Broken Hill Proprietary Company is enlarging the capacity of its steelworks at Newcastle while the Queensland Government has decided to establish State steel and iron works at Bowen. It is estimated that these will cost between $10,000,000 and $15,000,000 and employ, when in full operation, about 4,000 men. In view of the adverse rate of exchange with the United States an effort will be made to secure the machinery entirely in Great Britain and Australia. While the works are not likely to be completed for three years it is hoped to begin production 12 months after the arrival of the machinery. Railway rails for the State lines will bulk large in the output. A group of Scottish ironmasters is trying to arrange to work the iron deposits at Yampi Sound in Western Australia where there is a hill of exceptionally pure iron ore immediately on the shore of a fine harbor. It is officially estimated that there are 97,000,000 tons of ore of very light purity in sight above water-level while the total quantity is probably much greater. It has been proposed that the melting works should be established in Portuguese Timor, 300 miles from Yampi Sound, where manganese and fluxing materials are available while coal could be obtained from Borneo. It is unlikely, however, that the Australian Government will allow the ore to be exported to Timor and there is an alternative proposal to have the works at Gladstone, in Queensland, where plenty of coal is available close to a good port. There is a rise and fall of tide ranging up to 38 feet at Yampi Sound and if the problem of securing electric energy from the tides could be solved smelting could be done very cheaply on the spot. There is also a probability of a big iron and steel industry being developed at Loraina in the island of Celebes, a port of the Netherlands Indies. This has a field within 18 miles of a port estimated to contain something like 200,000,000 tons of ore yielding 50 per cent of metallic iron, chrome iron, nickel and manganese.

A clothes sprinkler made of aluminum after the fashion of a salt shaker

The Salt-Shaker Idea as a Clothes Sprinkler

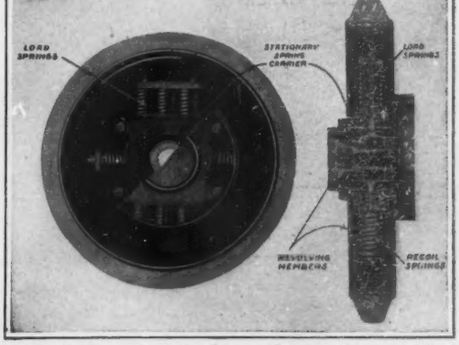
FOR the woman who still insists on doing some of her washing, a Bloomington, Ill., manufacturer of aluminum ware has brought out an aluminum clothes sprinkler. A screw top containing a large number of small needle-point holes affords an even spray of water. One filling of water should be sufficient for the average washing as it will hold a little more than a half pint of water.

A Resilient Wheel for the Solid-Tired Truck

A NOVEL form of resilient wheel designed for heavy power vehicles, operate on a new principle, has been recently devised. As illustration shows, the wheel is not built on the same principle that most spring wheels are. In the design outlined the wheel is mounted on an axle member and secondary springs surround this axle. A frame on each axle end is permanently positioned and in this there are eight coil springs, three being carried above and three below, while there is one spring on the back and one at the front of this frame. The springs are so placed that there is a certain degree of tension on them which is claimed to make for steadiness of action.

The construction of the resilient wheel is such that the load is carried by the upper springs and the recoil of these members is absorbed by the lower springs. The wheel has two sets of parts, one being stationary at all times, and the other capable of revolving. The rotating series includes the wheel disks, tires, bearing inner races and the wheel driving members. The stationary series comprises the bearing outer race, the spider block springs, spring bolts, spring bridge and spring plates, and these parts always maintain their position because the spring carrying block is keyed to the shaft or shaft housing depending upon the design of the axle. The horizontal front spring is compressed only when the clutch is engaged while the horizontal rear spring is loaded only when the brakes are applied.

It is stated by the builders of the new wheel that the factor of safety is so large in this design that there is no possibility of the springs breaking as the carrying capacity is 100 per cent greater than the capacity of the main frame supporting springs. By the use of this floating hub construction, it is advanced that great ease of riding is obtained, that the usual form of solid rubber tire is satisfactory under all conditions and that higher speeds are possible without damaging the mechanism, than can be obtained with the usual form of non-resilient wheel.

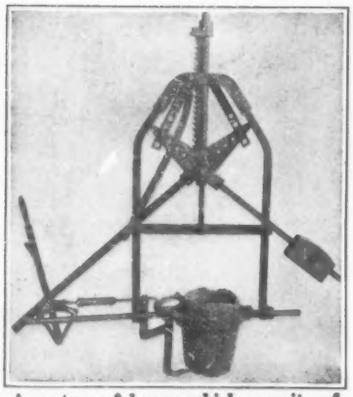


A resilient wheel for heavy duty service on the largest of present-day motor trucks

XUM

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



A system of levers which permits of one man handling a 400-pound ladle

A One-Man Ladle for the Efficient Foundry

IN the average small foundry where molten metal in small quantities is poured into molds for making light weight castings, it is usually necessary to carry the metal to the molds in small ladles called bull or shank ladles. This involves the liability of spilling the metal causing injury to the workmen or loss of the metal or both.

A new device, claimed to overcome these troubles and to represent the latest ideas, has been put in the market by a company of Detroit. The novel feature of the new device is that it is mechanical and is the product of scientific study. In foundries where these machines have been used, it is reported that they have quickly paid for themselves. One man, with this device, can pour almost three times as much as two with the old shank method and in less time, it is claimed. The pouring is more accurate with fewer spills and accidents, and with burns almost eliminated.

By means of a set of adjustable levers and a counterbalance a man gets mechanical advantage great enough to lift over 500 pounds. A ladle of 400 pounds capacity is easily lifted to a height of 18 inches, owing to the leverage.

The details of the mechanism for handling heavy ladles are shown in the accompanying illustration. The operating lever controlling the pouring of the ladle appears at the left, and the counterweight at the right.

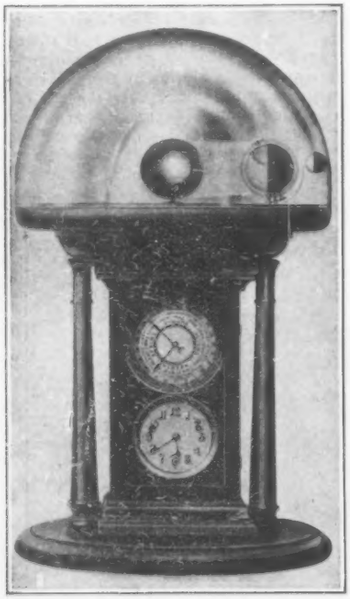
A Non-Skid Grip for the Motor Truck Wheels

IN the non-skid device being manufactured by a Connecticut factory, steel cross bars attached to electrically welded chains is one of the latest improvements for the motor truck using dual tires. The chain slips in between the tires and is locked tight. The steel cross bars overlapping the rubber of the tires are round on the tread of the tire. When coming in contact with sharp objects this round bar displaces the rubber passing over the object without damage to the tire or the bar. It is also claimed that the cross bars eliminate vibration.

The Life of a Tractor

THE amount of service which a tractor will perform before it must be replaced is obviously an important factor in determining its value for farm work. The United States Department of Agriculture has given serious study to this problem and while it cannot give any official figures that are definite as to the life of the tractor, it gives an average estimate of eight to ten years. Of course, the factors that influence the amount of service rendered by any given machine are, first and foremost, the care that it receives at the hands of the operator, then the quality of the outfit, the kind of work for which it is used, the service rendered by the organization that builds it and the skill with which it is designed and constructed. Nearly all tractors are used under conditions which are extremely severe for any kind of a machine. They travel over rough and uneven ground and work in an almost constant shower of dust and dirt, which is extremely hard on the wearing parts

Experimental motor truck fitted with a new type of non-skid arrangement on the rear wheels



An astronomical clock which shows the position of sun, earth and moon at a glance

What Time Is It by the Sun, Earth and Moon?

WHAT is said to be an improved astronomical clock represents the ideas and unrelenting work of an ingenious Chicagoan, Michael Bulka. This clock, which is shown in the accompanying illustration, exemplifies and illustrates the movements of the earth and moon around the sun, with the moon swinging about the earth. These various movements, in concert with the actual happenings, typify the four seasons of the year.

In a glass dome surrounding the clock are three globes representing the sun, earth, and moon. This group shows how the sun illuminates the earth and moon; how the earth revolves around its axis every twenty-four hours, giving us both day and night; how the earth travels around the sun, giving us the four seasons of the year; how the moon revolves around the earth, thus changing its illuminated area; and how the earth and moon together revolve around the sun, giving us the twelve months in the year. The eclipse of the sun and moon, when they occur, are plainly depicted by the mechanism. The globes representing the sun and the moon have been coated with phosphorous preparation which radiates rays of light. The clock has two dials indicating time of the year and of the day.

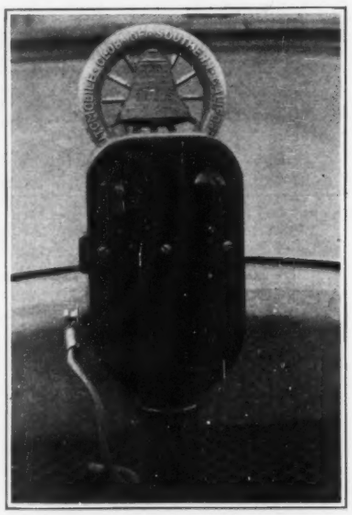
Colored Lights to Indicate the Speed of Cars

A SPEED indicator for motor vehicles "to be seen and read by all men" at a glance and that registers speed by the flash of colored lights, is the recent invention of Col. Charles Gore of Los Angeles.

The mechanism is encased in a metal box to be fastened to the front of the radiator. In the box or case are three large *eyes*, white, green and red, respectively. A regular speedometer cable connects the mechanism with the front wheels of the car, and when it begins to move the white light burns automatically.

This continues until the rate of travel passes the limit of the city ordinance, when the green light comes on, showing that the county rate is being used. If the driver exceeds that the red light flashes its signal of danger to all within seeing distance. Since the mechanism cannot be manipulated from within the car, it is impossible for the motorist to falsify his speed.

These lights lock automatically; hence if a driver breaks the city law for only a few minutes the green light will continue to burn after he has slowed down to the white range. By this means a traffic officer or any observer outside the car can tell by a glance what has been the rate of travel. In case of accident



White, green, and red lights serve to indicate the speed of the automobile

the lights burning will be conclusive evidence, registering either for or against him.

One who is an innocent victim of another's speed or a pedestrian's blunder will not be held up unnecessarily, causing vexatious delay, or, as is often the case, accused unjustly and convicted through mistaken or willfully lying witnesses. Likewise the guilty can be promptly dealt with, no time is lost, no confused witnesses summoned to court.

The city and county will also be saved much. Costly prosecution and wasted time are eliminated to the advantage of tax-payers. The immutable evidence of the mechanism means swift justice to all.

Something New in Hose Clamps

ONCE every so often a photograph has been staged in such an ingenious manner that it tells its own story. Such a photograph, we believe, accompanies these few lines. It depicts a new type of hose clamp at the left, and the old-style hose clamp at the right. The new type, it will be noted, is operated without tool of any kind; it is merely necessary to place the ring about the hose, adjust the ring to fit, and then press home the lever member, as shown. The old-style clamp requires a screw-driver and a pair of pliers, as shown at the right.

Copyright, Keystone View Co.

The new and the old types of hose clamps and how to apply them

The New Battleship "Indiana"

(*Continued from page 587*)

in together and united in a single structure as shown in our engraving. Although the arrangement looks very odd at first sight, it has the advantage of simplicity, and the even greater advantage that it removes the outflowing gases from the neighborhood of the navigating and fire-control positions that are clustered around the forward mast.

Immediately abaft No. 2 turret is the conning tower, which in these ships is built of enormous weight and strength, with an armor protection that will be proof against heavy shells at fighting ranges. The signal bridge surrounding the chart room and pilot house is extended around the top of the conning tower. A notable feature is the use of very long range-finders, 30 feet or more in length. These pass entirely through the turrets and have only their object glasses projecting on each side of the turrets. They are thus very effectively protected against shell fire. Attention is drawn also to the large number of searchlights provided, there being two on specially-prepared towers on each side of the smokestack, and a cluster of several at the first third of the height of the main mast. The complement of the "Indiana" will be about 1,500 officers and men.

The World's Greatest Shipping Terminal?

(*Continued from page 590*)

330,000 gallons. The average daily consumption is 1,800,000 gallons.

The water system at Hog Island is sufficient to supply a town of 30,000 people. It is interesting to note that water is pumped from the Delaware River, filtered, used for domestic purposes, filtered again and returned to the river in better condition than it was taken out.

There is one sewage disposal plant: a surface drainage system of two pumping plants using two sewage drying beds and one disinfecting house. The sewage system would take care of a municipality of 30,000 people.

Much of the machinery used in ship construction, etc., is operated by compressed air, which is supplied from 7 compressor houses. The compressor equipment consists of 19 cross compound compressor units direct connected to high voltage synchronous electric motors. The total capacity of this compressed air system is 73,675 cubic feet of air per minute requiring 14,250 horse-power.

The work of constructing the various utilities was carried on under the greatest imaginable handicaps, both as to isolation of location from transportation, water supply, bad drainage, weather conditions, labor conditions, and other causes coincident with the construction of the shipyard being carried on at one and the same time. During the winter months ground was frozen to a depth of 2 feet, and a considerable portion of the excavation required blasting. It was also necessary to thaw the ground by means of steam at times in order to permit excavation.

The terminal facilities at Hog Island are of such a nature that they might be made of great value as another terminal for our eastern coast. In fact, from information gathered from one source or another, it appears that it could be easily made one of the world's greatest terminals and the city of Philadelphia and the state of Pennsylvania would do well to acquire this plant as a site for such a terminal. Hog Island is one of the marked exceptions, in the entire war program in this respect: that is, building will be entirely justified as a terminal, aside from its shipbuilding facilities. Hog Island today occupies the position of being as good a salt water terminal or coast terminal as any in the United States. The terminal exists; and if the United States government wants to commence using it to-morrow morning as a terminal it can do so.

Let us review a few facts in regard to this plant as a terminal. The 26 wooden warehouses and the large concrete warehouse were designed so that they would be available as storage houses in a terminal scheme. Each warehouse is served by a railroad track for the entire length of the house and each warehouse has a platform adjoining a street for its entire length. In other words, each warehouse is available for its entire length to the railroad, to teams and to tracks on opposite sides of the house. The 25 miles of railroad track serves the 148 acres of steel, machinery and outfitting storage yards, and was designed to be available for the storage of any material that could be stored in the open.

In designing the seven outfitting piers, two standard steam railroad tracks were placed on each side of the pier with double cross-overs between each two tracks about the center of the pier. These two tracks serve every ship at the wet-basin piers, which helps in the speed of outfitting ships, and is very desirable when the piers are used as commercial piers in that the track on the outside of the pier can be used for flat cars containing heavy, bulky material and the freight on that track is within reach of the ship's tackle. On the inside track can be placed box cars containing freight which must be unloaded on the pier, and freight unloaded from box cars on the water side of the track is within reach of the ship's tackle.

Each of the seven piers is equipped with four self-propelling gantry cranes running on a wide-gage railroad track, which spans the outside railroad track on each side of each pier. The clearance under this gantry crane is sufficient to permit the operation of standard locomotives and cars. Each of these gantry cranes is equipped with booms 50 to 70 feet in length. In addition, each of the piers is equipped with two self-propelled locomotive cranes, and pier B is equipped on each side with a bridge crane with a span of 118 feet and 111 feet clearance from mean low tide with a lifting capacity of 100 tons, which is used for placing the turbines and reduction gears in the ships immediately after they are launched. The same crane is admirable for placing locomotives and other heavy articles in the holds of vessels.

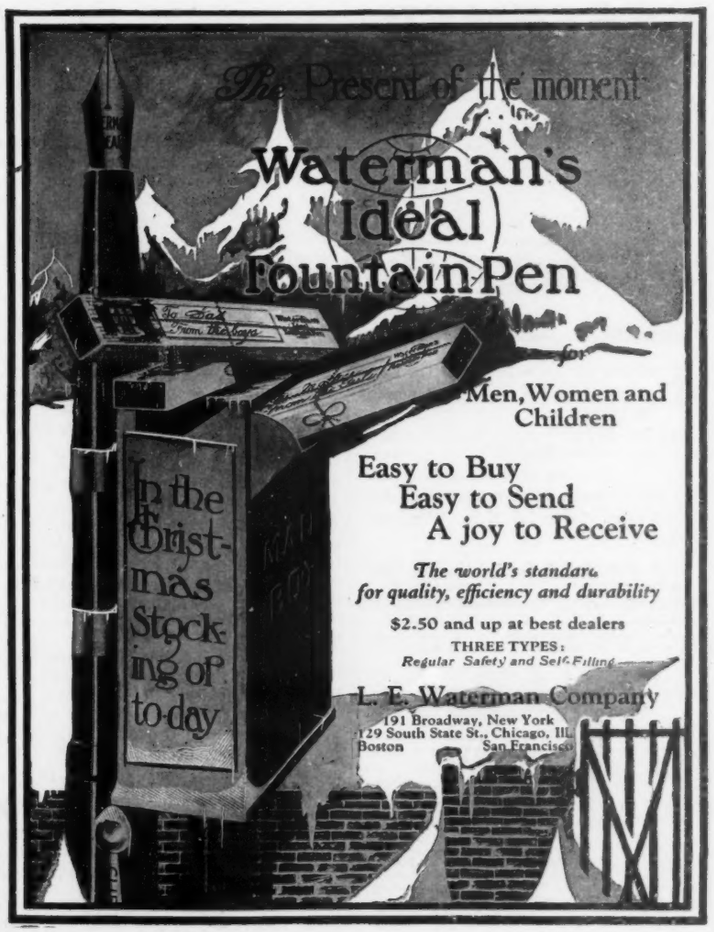
There do not exist at any commercial port in the United States any better equipped storage yards and storage houses or piers for commercial purposes. In fact, at no other commercial piers in the United States does there exist today 50 per cent of the modern appliances for the handling of cargo and the quick dispatch of vessels with economy and speed that are at this minute available at Hog Island with all details so thoroughly and painstakingly thought out and provided for.

From Wood to Cloth

(*Continued from page 591*)

minute splinters and particles by being held against grindstones. Strong paper is made from chemical pulp in which the fibers are separated by acid, as in the common sulfite process, or by alkalies, as in the soda and sulfate processes. The so-called "Kraft" paper, the term of Teutonic origin signifying strength, is made from undercooked, nonbleaching, brown pulp. This paper, true to its name, is remarkably strong and resistant to wear and is especially adapted for wrapping purposes.

The manufacture of paper textiles begins with a good grade of thin, tough paper of the Kraft type. This is cut by special machines into narrow ribbons from a sixteenth to half an inch in width, depending upon the size of the thread or yarn desired. The finest thread is made from a kind of tissue paper. These ribbons are rolled into flat, disk-like reels ready for spinning. If a white or light-colored yarn is wanted the paper used is



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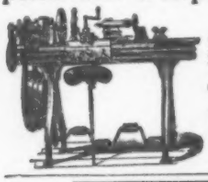

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made from bleached pulp. It is likely to be less strong.

The spinning is usually nothing more than the twisting tightly of a single paper ribbon. Such paper yarn breaks easily and with a short fracture. Sometimes several fine ribbons are spun together or several spun threads are twisted cable-like. Again an inner core of spun paper may be covered with the waste from other fibrous materials such as cotton and flax. The paper yarn may be "processed" to make it waterproof, though the efforts in this direction have not been entirely satisfactory. The best results have been obtained by the mixing of yarns and by tighter twisting of the paper.

There is nothing novel in the weaving process as the ordinary loom, bobbins and shuttles are used. Some textiles are woven entirely of paper yarn, others in mixture with cotton or nettle fiber. Pure paper textiles are rather stiff and coarse and are without nap. They are not suited for hard usage or wear and laundering must be done with extreme care, as wetting makes the "natural" paper cloth very tender. If such goods are to be exposed to the weather it is necessary to impregnate them with some water-proofing substance. The quality of the goods varies all the way from thin muslins and print cloths to heavy canvas and coarse matting.

That Germany found paper textiles of great help during the war is indicated by the wide range of uses to which the material was put. Among these may be mentioned, in addition to clothing, lining for gas masks, bed sheets and covers, straw mattress ticking, sand bags (mixed tissue), bread bags, cloths for wrapping feet (as worn by soldiers in place of socks), mull tissue for dressing wounds, sail canvas, uppers and inner soles of shoes, boot straps, belts, shoulder straps, galloons, braid, markers, insignia for prisoners of war, shoe laces, pack thread, twine and ropes. There were also many household uses such as matting and hall runners, table cloths and napkins, towels, wall covering, curtains, bed covers and sheets, pillow cases, lining and stiffening for clothing, and print goods for dresses and miscellaneous.

The manufacture of paper yarn was not due in the first place to the war, as long before that time, rugs, runners, curtains, wall hangings, twine and especially sacking were made from this material. The need produced by the war greatly stimulated and extended the use of such textiles. Along with the paper substitute for cotton might be mentioned nettle fiber, and the fibrous material of rush, broom and turf. Articles of apparel for men were made out of 25 per cent turf fiber and 75 per cent artificial wool.

Whether or not the paper textile industry has much of a future in store cannot be determined at present. Some of the German writers look upon it hopefully, and one speaks of the obvious significance of the discovery of the use of wood cellulose for "such purposes as sacking, roofing, binding, and for the materials for making pockets and the like." But scarcely for clothing.

A Giant of Old

(*Continued from page 591*)

brought from a head race at a little distance, but on the opposite side to that on which the power was delivered to the main-shaft. The water passed through a head gate arranged in the race. This gate admitted to a 48-inch brick conduit that led to the wheel. It should be understood that the wheel was set with the one side next to the face of a ledge or terrace. Naturally, this was the side next the head race. From the brick conduit a metal pipe led the power water up a short incline to the summit of the wheel. The pipe was continued on across the top of the wheel—in a direction parallel to the axis. The pipe was then continued downward, but with a greatly reduced diameter.

Perhaps it will be well to insert a brief explanation covering the principal features of an old-time wheel, so that our further consideration may be facilitated. There are five chief parts into which the structure may be divided. There is a shaft or hub, the arms or radial rods, the shrouding, the soling and the floats. The shrouding is the aggregate of the segmental pieces that corresponds in position to that of the felloe in a carriage wheel. The soling is the peripheral face. With the shrouding, it forms a kind of circumferential trough. The soling constitutes the convex flooring. The floats are the blades extending across the convex face of the wheel. They lie in the trough. In the case of the Burden wheel, the power water is fed to the wheel from the pipe length, or cylinder, which extends across its crest parallel to the axis.

The designer of the Troy wheel was Henry Burden, who came from Scotland to the United States in 1821, when he was 30 years of age. The wheel was constructed for the purpose of supplying power to an iron and nail factory whose business had become very considerable. The works were, and are still, located on the banks of a small tributary to the Hudson known as Wyants Kill. Not far away from them was Burden Falls which dropped the water of Wyants Kill a vertical distance of about 50 feet. Below the falls were a number of rapids. Altogether, there was a total available head of about 70 feet. Wyants Kill is the outlet of four lakes located some 10 miles distant. At the works, the drainage available is perhaps 36 square miles. A dam was built in the region of the four lakes and thus created a fifth. This proved to be a solution of the problem of storage and regulation. There would be, in fact, plenty of water at all seasons.

There were, it seems, five small water wheels; but Mr. Burden preferred to construct a single unit of large size. It is understood that construction began in 1838. In its early form, the wheel was operated not without difficulty. About 1851 it was rebuilt. In the earlier wheel one of the journals became excessively heated and broke off. In the rebuilt wheel, hollow journals were employed and provision made for the circulation of water over them. The wheel of 1851 is the same wheel whose south supporting pier gave way a few weeks after the Great War started. Only a few replacements seem to have been necessary. A wooden stave pipe was employed at first instead of the later riveted iron pipe. And about 1882, the segment gearing was replaced. These replacements and ordinary repairs sum up the maintenance of the wheel during a period of forty-five years, the wheel having stopped in 1896.

The dam which provided for the head race was only a few hundred yards above Burden Falls, so that no great length of water-way was required.

The great wheel was constructed mostly of wood. The soling consisted of Georgia pine in heavy pieces 10x10 inches in section. To these the 264 iron rods, which were of 1½-inch size, were secured. On this same soling, on top of the ends, the segmental gearing was attached.

It will be gathered from the foregoing that this great wheel must have been a heavy affair. And indeed, so it was. It is estimated that in a soaked condition the wheel must have weighed about 250 tons, so that 125 tons came on each bearing.

The power multiplication by the gearing was about 35. With the water wheel rotating at 2½ turns per minute, the flywheel would rotate at about 87½ turns per miute. This was the rate considered desirable. With the fluctuations of load in the shop, it was accordingly necessary to readjust the flow of the water in order to maintain a constant speed at the flywheel.

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Mr. F. R. I. Sweney has studied the Burden wheel, and has calculated its efficiency. He finds that at a constant flywheel speed of 2½ rotations per minute, a horse-power of 278 would be developed at an efficiency of 84.25 per cent. This efficiency relates only to the matter of hydraulics and takes no account of the frictional losses in the gearing.

The Needs of the Patent Office

(*Continued from page 592*)

vast extent of the developments in the arts as a warning against undue expectations of financial award from the receipt of a patent grant. It would benefit the public and the Office highly if the number of applications and patents granted were cut in two; if trivialities that now burden the processes of examination and the records were substantially reduced.

There are many other improvements that have and could be suggested, such as making the entrance to the patent bar more rigorous, limiting the number of claims in an application, restricting the life of a patent in accordance with its extent of prosecution in the office, etc., etc., but no attempt will be made to further treat this subject-matter than has already been done. It would take a volume to discuss its ramifications in all its phases. An exception, however, to the termination of this treatment must be exercised with relation to one thought. It has frequently been suggested that an exhibit of the more striking results of invention be placed on view in the Patent Office. Such an exhibit of models of the most notable inventions would undoubtedly bring a measure of public interest to the workings of the Office that does not now exist. The Patent Office needs the interest of the public very much. Not only would the public's interest to the benefit of the Office be aroused in a display of the fruits of the highest and most characteristic genius disclosed by the American people, but the public would be reciprocally profited by the receipt of information, in an intensified and never-forgotten form, of the beneficial effect the patent system has had in arousing that genius.

Once the public becomes conscious of the stupendous service to humanity conferred upon it by the activities of inventors, and the relation of the Patent Office to their output, it may not be beyond the limit of imagination to visualize a condition when the expectations as sketched in this paper may actually be realized.

Surveying America's Snows

(*Continued from page 594*)

stream-flow is the occasional lack of precipitation during April-June after the snow survey has been made. It has generally been considered that small amounts of rain such as usually fall in the semi-arid West have little influence on stream flow. And this is particularly true in the autumn when the rain falls directly upon the soil. However, in the spring when the snow fields stretch far down the slopes of the mountains toward the stream-gaging station, the greater part of the precipitation combines directly with the snow and obtains an "untaxed" passage with the latter into the stream below. Consequently, the lack of normal precipitation in April-June, when the snow fields are melting, causes a shrinkage in the seasonal percentage of the run-off indicated by the snow survey. This problem is met by postponing until the first day of May the final forecast of the stream flow in order to use the precipitation, the temperature, and the run-off for April as factors in determining the subsequent flow.

According to Dr. Church, a fallacy long prevalent has until the present prevented the application of snow surveying estimates to wide areas. This fallacy is the belief that storms are spotted and basins individual in their character so that the snow in one basin is not indicative of the relative amount in the next, and that even the snow cover in one part of a basin is not comparable to that in another.

"While this is particularly true in summer," he went on to explain, "and within narrow limits also in winter, the general correspondence of the stream flow in basins along the axis of the Sierra Nevada for distances of 150 miles, usually on one side of the range and sometimes on both, indicates the similar correspondence of the snow cover. Indeed, over a period of 9 years the usual maximum divergence has been between 8 and 15 per cent. The cause of the close correspondence is doubtless due in large measure to the heavy contribution by the 'big storms' that cover a large part of the range as they pass eastward. Hence, the result of a careful snow survey in any basin can usually be applied within 25 per cent to any other, and a series of surveys at wide intervals along the summit of the range will indicate the direction in which an increase or decrease in seasonal percentage of snow cover is to be expected."

Wanted: An Inexpensive House

(*Continued from page 596*)

only to selected contractors, who are given exclusive rights in certain territory.

Building one's own home at best these days is costly business. There is no escape through sheer good luck. Here and there some fortunate person may come across an old-fashioned house which requires certain minor improvements to bring it up to date—to make it available for the persons of today, so to speak. There are thousands of such houses throughout the land, which, lacking the very latest word in appointments, are apt to go begging for buyers. As a general rule such old houses include a most desirable piece of ground, with fine fruit trees, shade trees, flowers, hedges, and so on. Such things are priceless in the sense that they cannot be produced overnight to adorn the new home.

Much can be done with old-fashioned houses. With the dismantling of National Army cantonments here and there throughout the country, one can pick up various bits of equipment and material for remodeling old houses. Plumbing supplies, lighting fixtures, wiring materials, wall board, furnaces—all these things are available at low prices at the dismantled cantonments. All in all, an old house is apt to contain better lumber than the newer houses, and if the foundation, sills and main members are found to be in excellent condition, one can purchase such a house with full assurance that one has a good foundation on which to build and improve and finally evolve a comfortable and worth-while home. Here, indeed, is a first-rate opportunity for the man who is handy—and the woman, too, for there are many little touches about such a house that await the feminine mind and hand.

Venezuela's Mountain-Climbing Oil-Burning Locomotive

(*Continued from page 597*)

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and also of time, in raising steam in the locomotive at the commencement of work (cold machine). For this operation there was used in the present case a fixed machine that generated steam, which, by means of a tube was carried to the locomotive. It required 1½ hours to put this in readiness for movement, without the necessity of fire-wood or coal, while for the employment of those combustibles, 3 to 4 hours would have been expended;

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Yet another departure in railway operating methods in Venezuela is the substitution of electric trolley for steam power on short, fairly level stretches on the coast, about La Guaira, and on the mountain plateau about Caracas, which doubtless will be followed by like conversion on a larger scale elsewhere in the republic. These suggest further opportunities for American equipment and supply interests.

Music From Glass

(*Continued from page 598*)

perhaps a goodly total—scattered over the world. They are, in America at least, more of a curiosity than anything else. The sweetness and beauty of tone appears to be undeniable. But, apparently, the quality of the sound is such as to act unfavorably upon the nerves of some hearers. The musical critic, Fr. Rochlitz, in 1798, writes warmly in defense of the harmonica. He thought that it was as little injurious as any other expressive instrument. He recommended restraint in the enjoyment of this variety of music and thought its soft and pleasing tones should not be permitted to occupy the attention too much at night.

The success of the early harmonicas led to the desire to improve and vary. The effort was made to substitute something else for the human hand, but the success appears to have been only an indifferent one. There was difficulty in getting or continuing to get the peculiar and ethereal tone possible with the hand. However, the Abbot Mazzuchi invented a variety of harmonica which substituted the violin bow. The bells were inclosed in a case. It is said that the tones from this instrument were less exciting to the nerves of sensitive people. Another variation from the Franklin type uses little pegs with a pad at the end made of sponge as the means of vibrating the glass.

At the Metropolitan Museum of Art, New York City, there is (No. 1820) an English instrument consisting of 24 glasses standing on feet. There are one or two omissions, but the range appears originally to have been two complete octaves and two notes. At the same museum is an example of the Franklin type (No. 1211). This is a glass harmonica of 35 hemispherical glasses arranged on a rod. That is, the rod is placed horizontally and the various glasses are arranged on it in vertical "planes." This instrument dates back to the eighteenth century. The glasses originally provided a range of three octaves, but there are one or two missing. The diametrical sizes vary from 10½ to 3½ inches, and all are contained in a suitable case.

Benjamin Franklin's harmonica is not to be confused with musical glasses. It is, in reality, a mechanical device and not a mere collection of glass vessels. As this instrument seems never to have been essentially improved, the reader may be interested in learning precisely how it is constructed and operated. I follow Franklin's own account, given in a letter dated London, July 13, 1762.

Thirty-seven notes are desired. But a lesser number of glasses may be used. These are, each of them, approximately hemispherical. At the pole of the hemisphere is a neck not unlike that of an ordinary bottle. The largest diameter is 9 inches, the smallest 3. The diametrical size varies by intervals of ¼ inch; so that altogether there are 25 different diameters. A half dozen or more glasses are to be blown of each size and from these 150 or more hemispheres the 37 desired are to be obtained. The thickness of the glass at the edge is to be 1/10 inch or even less. The glass thickens somewhat as the neck is approached. This neck will vary for the different sizes. In the largest the neck will be, perhaps, 1 inch deep and 1½ inches wide within. The depth of the neck of the smallest glass should not be less than ½ inch. Having accumulated the considerable stock of hemispherical shapes, one is ready to begin the business of getting 3 octaves and 1 note from the lot.

A selection is made with two objects in view. First, one keeps before him the purpose of getting 37 notes that are either exactly the ones desired to make up the range or else are a trifle too sharp. Second, one seeks to get glasses that will fit fairly well, the one within the next larger. Assuming now that the choice has been made, one marks each glass with a diamond in such way as to indicate the note it is finally to utter. The glasses that are too sharp are reduced in pitch by grinding them in a zone of an inch or so in latitude, this zone being next the neck. Naturally, the glass should be tested from time to time to determine when it has suffered precisely the right reduction in pitch. Franklin recommends that as the right note is approximated, the glass be wiped clean and dry before testing, as the tone is flatter when the glass is wet. If the grinding be done by short stages near the finish, great exactness of pitch may be obtained. If, through inadvertence or otherwise, a glass be flattened too much, the brim may be ground off to remedy the matter. But this calls for polishing in order that a smooth surface may be present to the hand of the player later on.

The glasses, once they are tuned, are mounted in proper order upon a suitable spindle. As the general assemblage of glasses on the spindle produces a conical figure, viewed as a whole, the wooden case in which the group is to be arranged may follow this somewhat. That is, the case, while not departing from a form having a rectangular cross-section, may nevertheless taper toward one end. Franklin's case opened along a horizontal plane at a level intermediate between top and bottom. The spindle with its glasses upon being mounted in place was so disposed that upon opening the case the upper halves of all the hemispheres were disclosed. At the larger end of the spindle, a suitable fly wheel is mounted. A treadle is arranged, by suitable connections, so that the foot is enabled to rotate spindle and glasses. The spindle is set horizontally and mounted in brass gudgeons. Franklin's harmonica had a spindle of "hard iron," round in section, and tapering from a diameter of 1 inch at the fly-wheel end to ¼ inch at the other end. The big end is squared for the wheel. Franklin used a mahogany wheel 18 inches in diameter and rather thick—thick enough in fact to conceal a 25-pound weight of lead near the circumference. The wheel had six spokes, apparently. A pin of ivory was set in one and over it was passed the loop of the string connected with the treadle. Franklin states that the pin was located about 4 inches from the axis.

The fixing of the glasses on the spindle is done with the aid of corks. Thus, a cork is fitted into the neck of a glass and is allowed to project somewhat. The object of this projection is to prevent actual contact of glass with glass. When the corks have all been duly fitted, they are perforated to receive the spindle. Naturally, the perforations correspond with the spindle size at the proper location along its length. "When a glass is put on, by holding it stiffly between both hands, while another turns the spindle, it may be gradually brought to its place."

The playing is done by operating the spindle with its complement of hemispheres and laying the finger on the various glasses as the several notes may be required. The brim is the place from which the note is drawn. Franklin recommends that the tone be got by rotating the glasses away from the finger rather than toward it. His instrument had G (somewhat below "a common voice") for its lowest tone and then included all the usual tones in the three octaves above. The fingers are to be soaked in water, and are to be free from all greasiness. A little fine chalk may be used at times in order to bring the tone out the better. A considerable advantage is pointed out by Franklin—once tuned, retuning becomes unnecessary.

NEW BOOKS, ETC.

THE USE OF COLLOIDS IN HEALTH AND DISEASE. By Alfred B. Searle. New York: E. P. Dutton and Company, 1920. 8vo.; 120 pp.; illustrated.

Ostwald tells us that all life processes take place in a colloidal system; Sir Malcolm Morris, in his foreword, reminds us that this is equally true of normal body fluids and secretions and of bacterial toxins. If, then, medicines were administered in a colloidal state, careful investigators conclude that their remedial value would be higher. This book tells what results have already been achieved, and how scientific chemistry may surmount the difficulties presented by the instability of colloidal substances. It is a valuable contribution to a growing school of thought.

WHAT BIRD IS THAT? By Frank M. Chapman. New York and London: D. Appleton and Company, 1920. 12mo.; 144 pp.; 301 birds in color.

To the nature lover, the question put by this title is constantly recurring. In this unique little guide, the Curator of Birds in the American Museum of Natural History makes it easy to identify our feathered friends. His exceptional facilities have been drawn upon to the fullest extent, and the result is a work picturing and describing every land bird east of the Rockies. We have the distinguishing marks, range, nest, eggs, and song of each, and the localities and seasons where and when it may be looked for. The original treatment will at once strike the enthusiastic amateur.

THE NEW MERCHANT MARINE. By Edward N. Hurley. New York: The Century Company, 1920. 8vo.; 296 pp.; illustrated.

Mr. Hurley, having served his country to such splendid effect as chairman of the Shipping Board and president of the Emergency Fleet Corporation, leaves this book as a monument to our intensive achievements and a guide to future policy. With the history of American shipping as a background, his stage is occupied by sound suggestions. We have perils to avoid and opportunities to develop; these two objects are greatly forwarded by the thorough knowledge of conditions this work offers the foreign trader and the general reader. It enables us to think in terms of the future, and to shape the policies of the present to eventual supremacy on the seas of peace. It is ships that are rebuilding civilization, and ships that must protect and maintain it.

LANGUAGE FOR MEN OF AFFAIRS. Vol. I. Talking Business. By John Mantle Clapp. Vol. II. Business Writing. Edited by James Melville Lee. New York: The Ronald Press Company, 1920. 8vo.; 1192 pp.; illustrated.

Vol. I., "Talking Business," deals with the special language problems of the business man. How he puts his proposition often means success or failure; he cannot rely entirely upon the merits of his case, for his rival's probably has a few merits of its own. He must know how to best bring out the strong points and overrule objections, all in a winning and human way. Vol. II. exhibits the technique of business letters, reports, and advertising copy. The articles are written by men who are one with their subject. To catch the attention and subtly guide the mind of the prospect is a fascinating occupation that is here set forth step by step with thoroughness and clarity. The man who would increase the power of his tongue and his pen cannot do better than turn for help to this substantial work.